

GENERAL SPECIFICATION
FOR
REPAIR OPS CENTER CHILLER
FACILITY 1099

ARNOLD ENGINEERING DEVELOPMENT CENTER
ARNOLD AIR FORCE BASE, TENNESSEE 37389-9998

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SUMMARY OF WORK

PART 1 GENERAL

- 1.1 The work consists of providing all materials, labor, equipment, and transportation necessary to demolish and install one air-cooled chiller, one chilled water pump and install one air conditioning unit in AEDC Facility 1099, Test Support (Ops Center) Building as specified in the specifications herein and drawings referenced below. The building will be occupied at all times during the contract performance. Effort C Government representatives will provide support for installation of new equipment. The extent of the work is contained in the drawings and specification. Major items of work include, but are not limited to the following:
- A. Arnold Engineering Development Center (AEDC) Drawings:
 - 1. LET10083.CS1, Sheet CS1 (Cover Sheet)
 - 2. LET10083.M1, Sheet M1 (Partial Site Plan)
 - 3. LET10083.M2, Sheet M2 (Schedules & Details)
 - 4. LET10083.M3, Sheet M3 (Installation of A/C-3 in Room 202)
 - 5. 3-70-E343 Rev C2, Test Support Building Electrical Plot Plan
 - 6. 3-70-E344 Rev H3, Test Support Building Single Line Diagram
 - 6. TYTR8646, Rev C, Sheet E1 (Floor Plans & Details Facility #1099)
 - B. Demolish one air-cooled chiller with associated piping components (Ref 1.11C Work by Owner).
 - C. Demolish one chilled water pump with associated piping components.
 - D. Demolish one water-cooled packaged air conditioning unit with associated piping components (Ref 1.11C Work by Owner).
 - E. Provide one air-cooled chiller with associated electrical supply and piping components.
 - F. Provide one chilled water pump with associated electrical supply and piping components.
 - G. Provide one air-cooled split air conditioning unit with associated electrical supply, piping and ductwork components.
 - H. Provide a test and balance of the new equipment and systems.

1.2 RECORD (AS-BUILT) DRAWINGS

- A. Mark one full-sized copy of AEDC drawings (red-line) to accurately show as-built conditions during the progress of the job. Show all changes, additions, and deviations from the original drawings. If no changes occur, furnish certification to that effect. Submit to the Contracting Officer for approval prior to applying for final payment.

1.3 DEFINITIONS

- A. Certain terms used in the contract documents are defined below. Definitions and explanations contained in this section are not complete, but are general for the work to the extent that they are not stated more explicitly in another element of the contract documents.
 - 1. Furnish. The term "furnish" means to supply and deliver to the project site, ready for unloading, unpacking, assembly, installation, and similar operations.
 - 2. Install. The term "install" describes operations at the project site, including the actual unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimensions, finishing, curing, protecting, cleaning, and similar operations.
 - 3. Provide. The term "provide" means "provide complete in place"; that is, "furnish and install."
 - 4. Indicated. Where "as indicated" or words of similar import are used, it shall be understood that the reference is made to the drawings accompanying this contract unless stated otherwise.

1.4 CODES AND STANDARDS

- A. AEDC Safety Standard*:

- 1. E18 Managing Wastes Containing Chemical or Petroleum Products, 1998.

* The Government representative will furnish a copy of this Safety Standard to the contractor upon request.

- B. Air Force Federal Acquisition Regulation (AFFARS):

- 1. 5352.223-9000 Elimination of Use of Class I Ozone Depleting Substances (ODS), May 1996.

- C. Code of Federal Regulations (CFR):

- 1. 29 CFR 1926.1101 Asbestos, 2000.
 - 2. 40 CFR 261 Identification and Listing of Hazardous Waste, 2000.
 - 3. 40 CFR 370 EPA Hazardous Chemical Reporting and Community Right to Know Requirement, 2000.

1.5 JOB CONDITIONS

- A. Plan and execute this project in a manner to minimize downtime. Furnish new components and devices, complete, with all necessary materials for installation to meet this objective. Schedule all work in advance with the Government representative. Chilled water outages during the cooling season shall be limited to nights and weekends.
- B. Place all sanitary waste from lunches in local area dumpsters.

1.6 ASBESTOS PRODUCTS

- A. Do not use products or materials that contain asbestos on this project except as expressly authorized by the Contracting Officer. If no substitutes for asbestos products are available, and the Contracting Officer approves the use of asbestos products, highlight and detail their exact location on the drawings and identify their location in the field following 29 CFR 1926.1101 guidelines.

1.7 HAZARDOUS WASTE

- A. Where hazardous waste (as identified in 40 CFR 261) is generated, follow the procedures in AEDC Safety Standard E18, Chemical and Petroleum Products Waste Management, for storing and turning in hazardous waste. These procedures include the requirement to complete Forms GC-565 and GC-1337, which will be furnished by the Government representative.

1.8 DISALLOWED PRODUCTS

- A. Do not use products or materials that contain lead, chromium, mercury, cadmium, silver, barium, selenium, beryllium, or arsenic on this project except as expressly authorized by the Contracting Officer. If no substitutes for products containing the listed materials are available, and the Contracting Officer approves the use of products containing the listed materials, highlight and detail their exact location on the drawings.

1.9 ELIMINATION OF ODS CHEMICALS

- A. The use of Class I ozone depleting substances (ODS) is prohibited. Reference text of AFFARS clause 5352.223-9000 (May 1996).

1.10 HAZARDOUS MATERIAL IDENTIFICATION AND MATERIAL SAFETY DATA

- A. The following procedures shall be followed to meet 40 CFR 370, EPA Hazardous Chemical Reporting and Community Right to Know Requirement.
1. Procedures:
 - a. The contractor shall furnish information on the hazardous materials he brings on AEDC property prior to beginning on-site work. Hazardous materials may include solvents, paints, adhesives, acids, or any other substance which could be included within the definitions in paragraph 2.
 - b. The information required is:
 - 1) Company name, point of contact, and phone number.
 - 2) Brief statement indicating how the hazardous material will be used within the scope of the contract.
 - 3) List of all hazardous materials to be used (product name, manufacturer's name, and address).
 - 4) Amount of each material to be stored on site and where it will be stored.
 - 5) Where the product Material Safety Data Sheets (MSDS) will be maintained.
 - c. All unused product is the responsibility of the contractor and shall be removed from AEDC property at the completion of the project.
 - d. The contractor shall coordinate with the Government representative and the Hazardous Waste Operations Group (454-3628) if any hazardous waste is to be generated.
 2. Definitions
 - a. Hazard communication standard. A chemical right-to-know law under OSHA that requires chemical manufacturers and importers to assess the hazards of chemicals they make or import and to distribute this information to inform workers of the hazards associated with these chemicals. This written information is a Material Safety Data Sheet (MSDS).
 - b. Hazard classes. Hazardous materials that have been grouped into classes by the Department of Transportation (DOT). These classes include explosives, flammables, oxidizers and organic peroxides, compress gases, corrosives, and poisons.
 - c. Hazardous material. Any substance that may be harmful when used. Specific substances have been designated as hazardous under the Clean Water Act, the Resource and Conservation and Recovery Act, and the hazardous air pollutants under the Clean Air Act.
 - d. Hazardous waste. Any waste that may cause or significantly contribute to serious illness or death or that may pose a substantial threat to human health or the environment, if not properly managed.

Hazardous wastes may be solids, liquids, semi-solids, or compressed gases.

1.11 WORK BY OWNER

- A. The Government shall drain/capture the propylene glycol/water mixture in the chilled water system prior to demolition.
- B. The Government shall be responsible for adding propylene glycol back into the chilled water system at the appropriate time as determined by the Government representative.
- C. The Government shall remove and retain refrigerant and refrigerant oil from the existing air-cooled chiller and the existing air conditioning unit in Room 202.

END OF SECTION

SECTION 01060
REGULATORY REQUIREMENTS

PART 1 GENERAL

- 1.1 This section lists regulations, codes, and standards which specify procedural and administrative requirements imposed upon the work.
- 1.2 The contractor shall comply with provisions of the following documents to the extent referenced herein.

A. Government documents:**1. AEDC Safety Standards*:**

- | | | |
|----|-----|---------------------------------------------------------|
| a. | A6 | User and Subcontractor Safety, 1996. |
| b. | A9 | Hazard Communication, 1996 |
| c. | B1 | Work Clearances, 1998. |
| d. | B5 | Confined Spaces, 1997. |
| 3. | E7 | Asbestos, 1997. |
| e. | E17 | Oil and Hazardous Substances Spill Response, 2000. |
| f. | E18 | Chemical and Petroleum Products Waste Management, 1998. |
| g. | E19 | Lead and Heavy Metals, 1997. |

* The Government representative will furnish a copy of these Safety Standards to the contractor upon request.

2. Air Force Federal Acquisition Regulation (AFFARS):

- | | | |
|----|---------------|---------------------------------------------------------------------------|
| a. | 5352.223-9000 | Elimination of Use of Class I Ozone Depleting Substances (ODS), May 1996. |
|----|---------------|---------------------------------------------------------------------------|

3. Code of Federal Regulations (CFR):

- | | | |
|----|------------------|--------------------------------------------------------------------------|
| a. | 29 CFR 1910.134 | Respiratory Protection, 2000. |
| b. | 29 CFR 1910.1200 | Hazard Communication, 2000. |
| c. | 29 CFR 1926.55 | Gases, Vapors, Fumes, Dusts, and Mists, 2000. |
| d. | 29 CFR 1926.57 | Ventilation, 2000. |
| e. | 29 CFR 1926.59 | Hazard Communication, 2000. |
| f. | 29 CFR 1926.62 | Lead Standard, 2000. |
| g. | 29 CFR 1926.1101 | Asbestos, 2000. |
| h. | 40 CFR 61 | National Emission Standards for Hazardous Air Pollutants (NESHAP), 2000. |
| i. | 40 CFR 260 | Hazardous Waste Management Systems: General, 2000. |
| j. | 40 CFR 261 | Identification and Listing of Hazardous Waste, 2000. |
| k. | 40 CFR 262 | Generators of Hazardous Waste, 2000. |

- l. 40 CFR 370 EPA Hazardous Chemical Reporting and Community Right to Know Requirement, 2000.
- m. 49 CFR 172 Department of Transportation (DOT) Regulations for Use of Hazardous Materials Tables and for Communication, 2000.
- n. 49 CFR 178 DOT Specifications for Packaging, 2000.
- 4. Environmental Protection Agency (EPA) Document:
 - a. SW-846 Proposed Sampling and Analytical Methodologies for Additions to Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, 1984.
- 5. Public Law (PL):
 - a. 101-637 The Asbestos School Hazard Abatement Reauthorization Act (ASHARA), 1992.
- 6. Tennessee Department of Environment and Conservation Standard:
 - a. Chapter 1200-3-11-02 Hazardous Air Contaminants, Asbestos, 1998.
- B. Non-Government documents:
 - 1. Associated Air Balance Council Standard (AABC):
 - a. MN1-89 National Standards.
 - 2. American National Standards Institute (ANSI) Standards:
 - a. Z9.2-91 Fundamentals Governing the Design and Operation of Local Exhaust Systems.
 - b. Z88.2-92 Respiratory Protection.
 - 2. Air-Conditioning and Refrigeration Institute (ARI) Standard:
 - a. 550-98 Water Chilling Packages Using the Vapor Compression Cycle.
 - 3. American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) Standard:
 - a. Systems Handbook: Testing, Adjusting, and Balancing.
 - b. 15-94 Safety Code for Mechanical Refrigeration.
 - c. 90A-80 Energy Conservation in New Building Design.
 - 4. American Society of Mechanical Engineers Boiler & Pressure Vessel Codes (ASME B&PVC) Standard:
 - a. SEC VIII-98 Rules For Construction of Pressure Vessels Non-Interfiled.
 - b. SEC IX-98 Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators.
 - 5. American Society of Mechanical Engineers (ASME) Standards:
 - a. A13.1-96 Scheme for the Identification of Piping Systems.
 - b. B16.3-98 Malleable Iron Threaded Fittings Class 150 and 300
 - c. B16.18-84 Cast Copper Alloy Solder Joint Pressure Fittings.
 - d. B16.22-95 Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

- e. B31.9-96 Building Services Piping.
- f. B40.1-98 Pressure Gauges and Gauge Attachments
- 6. American Society for Testing and Materials (ASTM) Standards:
 - a. A53-99 Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - b. A234-00 Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
 - c. B8-99 Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
 - d. B32-00 Solder Metal.
 - e. B88-99 Seamless Copper Water Tube.
 - f. B209-00 Aluminum and Aluminum-Alloy Sheet and Plate.
 - g. B280-99 Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
 - h. C177-97 Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
 - i. C335-95 Steady-State Heat Transfer Properties of Horizontal Pipe Insulation.
 - j. C518-91 Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
 - k. C534-00 Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
 - l. C553-92 Mineral Fiber Blanket Thermal Insulation for commercial and Industrial Applications.
 - m. C921-89 Properties of Jacketing Materials for Thermal Insulation.
 - n. D1056-00 Flexible Cellular Materials-Sponge or Expanded Rubber.
 - o. E1-98 ASTM Thermometers.
 - p. E77-98 Inspection and Verification of Thermometers.
 - q. E84-01 Surface Burning Characteristics of Building Materials.
 - r. E96-00 Water Vapor Transmission of Materials.
- 7. American Welding Society (AWS) Standards:
 - a. A5.8-92 Filler Metals for Brazing and Braze Welding.
- 8. National Electrical Manufacturer's Association (NEMA) Standards:
 - a. 250-97 Enclosures for Electrical Equipment (1000 Volt Maximum).
 - b. ICS 6-93 Industrial Control and Systems Enclosures.
- 9. National Fire Protection Association (NFPA) Standards:
 - a. 70-98 National Electrical Code (NEC).

- b. 90A-99 Installation of Air Conditioning and Ventilating Systems.
 - 10. National Environmental Balancing Bureau (NEBB) Standard:
 - a. NEBB Specifications--Testing, Adjusting, and Balancing of Environmental Systems, 1991.
 - 11. Sheet Metal and Air-Conditioning Contractors' National Association, Inc. (SMACNA) Standards:
 - a. Rectangular Industrial Duct Construction Standard (RIDCS), 1980.
 - b. HVAC Duct Construction Standards - Metal and Flexible, 1995.
 - 12. Steel Structures Painting Council (SSPC) Standard:
 - a. Guide 7-95 Guide for the Disposal of Lead-Contaminated Surface Preparation Debris.
 - 13. Underwriters Laboratories, Inc. (UL) Standards:
 - a. 1-00 Flexible Metal Conduit.
 - b. 6-00 Rigid Metal Conduit.
 - c. 50-99 Enclosures for Electrical Equipment.
 - d. 98-98 Enclosed and Dead-Front Switches.
 - e. 181-96 Factory-Made Air Ducts and Connectors.
 - f. 198E-88 Class R Fuses.
 - g. 360-97 Liquid-Tight Flexible Steel Conduit.
 - h. 393-96 Safety Indicating Pressure Gauges for Fire-Protection Service.
 - i. 465-82 Safety Central Cooling Air Conditioners.
 - j. 489-00 Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.
 - k. 514A-98 Metallic Outlet Boxes.
 - l. 514B-98 Fittings for Cable and Conduit.
 - m. 586-99 Safety High-Efficiency, Particulate, Air Filter
 - n. 723-96 Surface Burning Characteristics of Building Materials
 - o. 797-00 Electrical Metallic Tubing.
 - p. 1581-00 Electrical Wires, Cables, and Flexible Cords.
- C. Drawings:
- 1. LET10083.CS1, Sheet CS1 (Cover Sheet)
 - 2. LET10083.M1, Sheet M1 (Partial Site Plan)
 - 3. LET10083.M2, Sheet M2 (Schedules & Details)
 - 4. LET10083.M3, Sheet M3 (Installation of A/C-3 in Room 202)
 - 5. 3-70-E343 Rev C2, Test Support Building Electrical Plot Plan
 - 6. 3-70-E344 Rev H3, Test Support Building Single Line Diagram
 - 7. TYTR8646, Rev C, Sheet E1 (Floor Plans & Details Facility #1099)

END OF SECTION

SECTION 01340
SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

PART 1 GENERAL

1.1 DESCRIPTION OF REQUIREMENTS. This section specifies procedural requirements for non-administrative submittals, including shop drawings, product data, samples, and other miscellaneous work-related submittals. These submittals are required to amplify, expand, and coordinate other information contained in the contract. Non-work-related submittals are addressed elsewhere in the contract rather than in the specification and may include items such as: contract progress schedule, permits, payment applications, performance and payment bonds, insurance certificates, and progress reports.

- A. Shop drawings. These are technical drawings and data specially prepared for this project including fabrication and installation drawings, setting and seaming diagrams, and coordination drawings (for use on-site).
- B. Product data. This data includes standard printed information on manufactured products that has not been specially prepared for this project, including manufacturers' product specifications and installation instructions, standard color charts, catalog cuts, standard wiring diagrams, and standard product operating and maintenance manuals.
- C. Samples. These are physical examples of work, including, swatches showing color, texture, and pattern, color-range sets, and units of work to be used for independent inspection and testing.
- D. Miscellaneous submittals. These are work-related, non-administrative submittals that do not fit in the three previous categories, including the following:
 - 1. Maintenance agreements.
 - 2. Survey data and reports.
 - 3. Project photographs.
 - 4. Record drawings (as-built drawings).
 - 5. Field measurement data.
 - 6. Operating and maintenance manuals.
 - 7. Keys and other security protection devices.
 - 8. Maintenance tools and spare parts.
 - 9. Overrun or maintenance stock.
 - 10. Qualification certificates.

1.2 SUBMITTAL PROCEDURES

- A. Coordination. Coordinate the preparation and processing of submittals with the performance of the work. Coordinate each submittal with other submittals and related activities, such as testing, purchasing, fabricating, and delivering, that require sequential activity.
- B. Listing. At the end of this section is a summarized listing of the submittals required for the work. The listing is included for the convenience of users of the contract documents.
- C. Transmittal timing. Prepare and transmit each submittal to the Contracting Officer sufficiently in advance of the scheduled performance of related work and other applicable activities. Transmit different kinds of submittals for the same unit of work so that processing will not be delayed by the Government's need to review submittals concurrently for coordination.
- D. Review time. Allow sufficient time so that contract performance will not be delayed as a result of the time required to properly process submittals, including time for re-submittals, if necessary. Allow 10 working days for initial Government processing of each submittal. No extension of time will be authorized because of the contractor's failure to transmit submittals to the Government sufficiently in advance of the work.
- E. "Approval" submittals. Submittals requiring approval by the Contracting Officer are so designated in the applicable sections and the submittal list at the end of this section. When brand names or equal are specified, any "equal" submitted will require approval. Any submittal requesting a deviation will require approval. Do not install any equipment or material requiring approval submittals until approvals are received from the Contracting Officer. The Government will status receipt or approval of all submittal requirements in the last two columns.
- F. "Information only" submittals. Submittals not requiring the Contracting Officer's approval are considered to be "information only" submittals.

1.3 SPECIFIC SUBMITTAL REQUIREMENTS. Submittal requirements for individual units of work are specified in the applicable specification section. Except as otherwise indicated in the individual sections, comply with the following requirements for each type of submittal.

- A. Shop drawings. Information required on shop drawings includes dimensions, identification of specific products and materials which are included in the work, compliance with specified standards, and notations of coordination requirements with other work. Provide special notations of dimensions that have been established by field measurements. Highlight, encircle, or

otherwise indicate deviations from the contract documents on the shop drawings. Furnish one reproducible and four copies.

- B. Product data. General information required specifically as product data includes manufacturers' standard printed recommendations for application and use, compliance with recognized standards of trade associations and testing agencies, the application of their labels and seals (if any), special notation of dimensions which have been verified by way of field measurement, and special coordination requirements for interfacing the material, product, or system with other work. Furnish four copies.
- C. Samples. Submit samples for the Contracting Officer's visual review of general kind, color, pattern, and texture for a final check of the coordination of these characteristics with other related elements of the work and for quality control comparison of these characteristics between the final sample submittal and the actual work as it is delivered and installed.
- D. Miscellaneous submittals. These submittals include the following:
 - 1. Inspection and test reports. Furnish three copies of such reports.
 - 2. Record drawings.
 - 3. Operating and maintenance data. Furnish three bound copies of operating data and maintenance manuals.
 - 4. Materials and tools. Refer to individual sections of the specification for required quantities of spare parts, extra and overrun stock, maintenance tools and devices, keys, and similar physical units to be submitted.
 - 5. Certifications, reports, instructions, and lists. Furnish three copies of such submittals.

1.4 REQUIRED SUBMITTALS

No.	Section Reference	Submittal Description	App	Info	Approval Authority	Initial /Date
1	01010 para 1.2A	Record Drawings	X			
2	02080 para 1.3A	Employee Certificate	X			
3	02080 para 1.3B	Training and Medical Certifications		X		
4	02080 para 1.3C	Training and Hazard Communications Certification	X			
5	02080 para 1.3D	Product List	X			
6	02080 para 1.3E	Equipment List	X			
7	02080 para 1.3F	Notice of Violation		X		
8	02080 para 1.3G	Environmental, Health, and Safety Plan	X			
9	02080 para 1.3H	Asbestos Removal Plan	X			
10	02080 para 1.3I	Air Sampling Reports		X		

Table I. Required Submittal List - Continued

No.	Section Reference	Submittal Description	App	Info	Approval Authority	Initial /Date
11	02080 para 1.3J	Testing Certifications		X		
12	02080 para 1.3K	CPR Certification		X		
13	02080 para 1.3L	Insurance Coverage Certification		X		
14	02080 para 1.3M	Sampling List	X			
15	02080 para 1.3N	Operator's Log and Shipper's Log	X			
16	02080 para 1.3O	Daily Logs: Sign-In and Field Notes		X		
17	02085 para 1.4A	Employee Certification		X		
18	02085 para 1.4B	Training and Medical Certification		X		
19	02085 para 1.4C	Notice of Violation		X		
20	02085 para 1.4D	Environmental, Health, and Safety Plan	X			
21	02085 para 1.4E	Training and Hazard Communications Certification	X			
22	02085 para 1.4F	Product List	X			
23	02085 para 1.4G	Lead Abatement Plan	X			
24	02085 para 1.4H	Air Sampling Reports		X		
25	02085 para 1.4I	Testing Laboratory Qualifications		X		
26	02085 para 1.4J	Air Monitoring Results		X		
27	02085 para 1.4K	Equipment List		X		
28	02085 para 1.4L	Rental Equipment List	X			
29	02085 para 1.4M	Shower Water Test Results		X		
30	15105 para 1.4B	Welder's Certificate	X			
31	15140 para 1.4A	Product Data		X		
32	15260 para 1.3A	Product Data	X			
33	15290 para 1.3A	Product Data	X			
34	15290 para 1.3B	Manufacturer's Installation Instructions	X			
35	15540 para 1.3A	Product Data				
36	15621 para 1.3A	Shop Drawings	X			
37	15621 para 1.3B	Product Data	X			
38	15621 para 1.3C	Written Certification of Components	X			
39	15621 para 1.3D	Manufacturer's Installation Instructions	X			
40	15621 para 1.3E	Performance Data	X			
41	15990 para 1.3A	Testing, Adjusting, and Balancing Reports	X			
42	15990 para 1.3B	Project Record Documents	X			
43	15990 para 1.3C	Adjusting and Balancing Agency	X			
44	16120 para 1.3A	Product Data	X			
45	16130 para 1.3A	Manufacturer's Descriptive Literature	X			
46	16190 para 1.3A	Product Data	X			
47	16440 para 1.3A	Equipment and Materials List		X		

Table I. Required Submittal List - Continued

No.	Section Reference	Submittal Description	App	Info	Approval Authority	Initial /Date
48	16440 para 1.3B	Manufacturers' Descriptive Literature	X			
49	16475 para 1.3A	Equipment and Materials Listing		X		
50	16475 para 1.3B	Manufacturer's Descriptive Literature	X			
51	16480 para 1.3A	Equipment and Materials Listing		X		
52	16480 para 1.3B	Manufacturer's Descriptive Literature	X			

Table I. Required Submittal List - Completed.

END OF SECTION

PART 1 GENERAL**1.1 SECTION INCLUDES**

- A. Removal and disposal of asbestos materials.

1.2 CODES AND STANDARDS**A. AEDC Safety Standards:**

1. A9 Hazard Communications, 1996.
2. B5 Confined Spaces, 1997.
3. E7 Asbestos, 1997.
4. E18 Chemical and Petroleum Products Waste Management, 1998.

B. American National Standards Institute (ANSI) Standards:

1. Z9.2-91 Fundamentals Governing the Design and Operation of Local Exhaust Systems.
2. Z88.2-92 Respiratory Protection.

C. American Society of Mechanical Engineers (ASME) Standard:

1. A13.1-96 Scheme for the Identification of Piping Systems.

D. Code of Federal Regulations (CFR):

1. 29 CFR 1910.134 Respiratory Protection, 2000.
2. 29 CFR 1910.1200 Hazard Communication, 2000.
3. 29 CFR 1926.55 Gases, Vapors, Fumes, Dusts, and Mists, 2000.
4. 29 CFR 1926.59 Hazard Communication, 2000.
5. 29 CFR 1926.1101 Asbestos, 2000.
6. 40 CFR 61 National Emission Standards for Hazardous Air Pollutants (NESHAP), 2000.
7. 40 CFR 260 Hazardous Waste Management Systems: General, 2000.
8. 40 CFR 261 Identification and Listing of Hazardous Wastes, 2000.

E. Public Law (PL):

1. 101-637 The Asbestos School Hazard Abatement Reauthorization Act (ASHARA), 1992.

F. Tennessee Department of Environment and Conservation Standard:

1. Chapter 1200-3-11-02 Hazardous Air Contaminants, Asbestos, 1998.

1.3 SUBMITTALS

- A. Evidence satisfactory to the Contracting Officer that the firm removing asbestos has at least one designated employee on site during all abatement activity who has received certification by completing an Asbestos Abatement Contractor Training Course approved or sponsored by the U. S Environmental Protection Agency (EPA) and who will be responsible for the work whenever any phase of the project is in progress. The course shall be a 5-day supervisory course. A 1-day supervisory refresher course also is acceptable if documents showing completion of the initial 5-day course are submitted and the refresher course or courses have been completed within the required time frame to maintain currency in EPA certifications. This training shall have been completed within 12 months prior to the bid opening date. Certification shall remain current throughout the course of the job and shall comply with 40 CFR 61 and PL 101-637.
- B. Written certification that all employees involved in the asbestos removal have received training and medical examinations as required by 29 CFR 1926.1101 and 29 CFR 1910.134, respectively. Certification includes respirator fit test records and a copy of respirator operating procedures and program, as specified in 29 CFR 1910.134. Include with the certifications dates of the most recent training, medical examinations, and a physician's statement indicating that workers are physically able to perform asbestos work and use the required respiratory and general body protection. Provide this information for all personnel including management and any air monitoring personnel on the job site before their first entry onto the job site. Keep information current during all phases of the job.
- C. A copy of the hazard communications program and certification that all employees have been trained concerning the hazard communications standards and the written program in accordance with 29 CFR 1910.1200 and/or 29 CFR 1926.59.
- D. A list of products to be used and a Material Safety Data Sheet (MSDS) for each. Products include, but are not limited to, aerosol sprays of any kind, wetting and cleaning agents, fuels, solvents, and paints. MSDS's will be kept in a notebook and will be indexed for easy reference. This MSDS notebook shall remain available to all employees on the job site at all times.
- E. A list of all equipment to be used and manufacturers' literature showing that the equipment and materials meet all EPA, Occupational Safety and Health Administration (OSHA), and ANSI standards for use in asbestos abatement activities. Do not use materials that are or will create hazardous waste as described in 40 CFR 261.
- F. Any citation or notice of violation from any Government agency issued as a result of work performed under this contract or any contract conducted in the

last three years. If none have been received, submit a letter certifying that none have been received.

- G. Environmental, health, and safety plan that addresses all environmental, health, and safety aspects of the job. Submit this plan within 30 calendar days after award of the contract and before any field work begins. Include methods to ensure safety including a lockout/tagout plan; job safety analysis; tool box safety meeting minutes; accident reports and investigations; lead-testing data/certification; fall protection systems; shop drawings; procedures for disposing of waste, scrap, and excess materials; and procedures for work involving transportation or disposal of hazardous waste. The plan shall address all other environmental, health, and safety concerns associated with the job, including a hazardous waste management plan in accordance with 40 CFR 260, a fire safety plan, and procedures for addressing other emergencies within the work area and in compliance with 29 CFR 1926.55.
- H. Asbestos removal plan including the precautions to be taken in this work. Do not proceed without the Contracting Officer's written approval of the plan. The plan shall include location of control areas and change rooms; layout of change rooms; location of hot and cold running water shower facilities; types of air machines used; kinds of interface of trades involved in the construction; schedule for sequencing of asbestos-related work; plan for asbestos disposal; type, manufacturer, and name of wetting agent and asbestos sealer to be used; air monitoring; and a detailed description of the pollution control method to be used. The plan shall also state the method proposed to handle oversized asbestos material (too large for bagging). Include dates of proposed work commencement and completion (by phases, if more than one phase is required or proposed).
- I. Air sampling reports are to include the results of daily area and personal air and excursion limit sampling along with negative pressure differential documentation.
- J. Testing certifications.
 - 1. Evidence that all air sampling is analyzed by a laboratory in full compliance with the OSHA Reference Method and which participates in an inter-laboratory quality assurance program or is accredited by the American Industrial Hygiene Association.
 - 2. Evidence that all persons analyzing samples have successfully completed the required National Institute for Occupational Safety and Health (NIOSH) and EPA-approved courses and been certified proficient by successfully participating in a NIOSH Proficiency Analytical Testing (PAT) (air) or National Institute of Standards and Technology (NIST) program within the last year.
 - 3. Should the contractor choose to collect and analyze bulk samples, submit evidence that the laboratory analyzing asbestos bulk samples is a NIST-accredited laboratory. (Bulk samples may be collected only with the

permission of the Contracting Officer and shall be returned to AEDC for disposal.)

- K. Certification that persons monitoring work in confined spaces have successfully completed a course in cardiopulmonary resuscitation (CPR) by the American Red Cross or the American Heart Association.
- L. Evidence that the firm removing asbestos has suitable insurance to cover any asbestos liabilities.
- M. A list of the sampling numbers required by paragraph 3.1B.
- N. AEDC asbestos landfill Operator's Log and Shipper's Log (Form GC-1622). This form will be provided by the Government representative.
- O. Daily logs.
 - 1. Sign-in logs will be submitted at least monthly and when the job is completed. Sign-in logs will include the following information for all persons entering the controlled area:
 - a. First and last name (must be legible).
 - b. Company and organization.
 - c. Social security number.
 - d. Date and time of arrival and departure.
 - e. Reason of visit.
 - 2. Field notes will also be submitted at least monthly and when the job is completed.

1.4 QUALITY ASSURANCE

- A. Demolish, remove, and dispose of asbestos materials as indicated on the drawings and specified herein. For the purposes of this specification, full-gross removal containment is required for any removal activity that takes two people over four hours to complete or that is required in 29 CFR 1926.1101. During removal, workers shall not leave the enclosure except for life-threatening emergencies. This applies only to removal activity and not to enclosure construction or final area clean-up.
- B. Use glove bag techniques as described in 29 CFR 1926.1101 and paragraph 3.7C, for small sections. If samples taken during initial glove bag work exceed 0.01 fiber per cubic centimeter (f/cc), stop the job and remove all remaining asbestos using full-gross removal containment. Gross removal methods utilizing full decontamination units as described in 29 CFR 1926.1101, Appendix F, shall be the method of removal.
- C. On small sections of pipe, valves, or other small areas of abatement where the glove bag is not suitable and full-gross removal containment is not required, mini-enclosures as specified in 29 CFR 1926.1101 may be used.

Mini-enclosures shall be equipped with high-efficiency particulate air (HEPA) filtered exhaust ventilation.

D. Assume unidentified insulating material to be asbestos.

PART 2 PRODUCTS

2.1 AIR RETURN FILTERS

A. 1-inch-thick disposable random fiber.

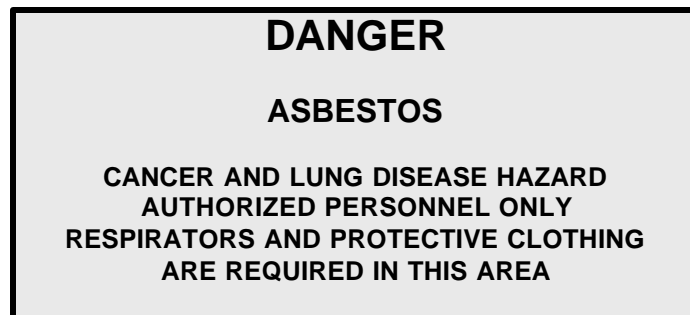
2.2 ENCAPSULANTS

A. Dryable to clear appearance and paintable with standard latex paints (American Coatings Corporation Cable Coating 22P Penetrating Sealant and Lock Down, or approved equal).

PART 3 EXECUTION

3.1 **CONTROL OF WORK:** Control work locations where the generation of asbestos dust could expose persons not properly protected.

A. Use safety ropes and barricades and post with 20-inch by 14-inch signs bearing the following warning:



B. Record all sampling numbers identified on asbestos material to be removed.

C. Ensure isolation of the work area or construction of the enclosure complies with 29 CFR 1926.1101. In addition, a continuous layer of true 6-mil polyethylene or other impermeable material shall first be applied to the floor and extend 12 inches up the wall. Use a layer of true 4-mil polyethylene for the first wall and ceiling and extend 12 inches onto the floor. Place the second layer of true 6-mil polyethylene on the floor and extend 18 inches up the wall and follow by the second layer of true 4-mil polyethylene on the walls and ceiling and extend 18 inches onto the floor. Polyethylene used for floors and walls shall be installed in such a manner to prevent ballooning of the polyethylene from the walls or floors. Drop and splatter sheets shall also be used in all containments in addition to the use of the two layers of polyethylene on the walls and the three layers on the floors of the

containment. In special situations, such as enclosures constructed outside, you may elect to construct the entire containment out of true 6-mil polyethylene or other impermeable material also supported by plywood or other rigid material.. Coordinate such construction with the Government representative. Enclosures constructed to contain asbestos work such as around equipment, utility systems, windows, doors, or other industrial systems shall be constructed of lumber (such as two by fours) or other rigid material supported on centers no greater than 48 inches apart and in a manner that shall maintain the integrity of the containment and prevent containment failure and release of asbestos fibers outside the work area. The use of wire, cable and other non-rigid systems shall not be used as containment framework or to otherwise hold polyethylene unless also supported by lumber or other rigid material on no greater than 48-inch centers. Support of polyethylene by wire, cable or other non-rigid materials by themselves shall not be allowed. Polyethylene sheeting shall be attached to the lumber or other rigid material and held in place through the use of spray glue, wooden screen molding nailed or screwed in place, duct tape and/or other mechanical methods.

- D. Construct hygiene facilities for decontamination of workers and equipment in the same way except use true 6-mil polyethylene for walls, ceiling, and floor. Hygiene facilities for decontamination of workers and equipment must be contiguous with the work area in all instances. Construct doors so that flaps completely isolate the rooms in the event of air exhaust ventilation failure and allow easy access for personnel and equipment. The clean room shall be large enough to accommodate at least three workers. Prevent direct viewing into the shower, clean room, or dirty room by other personnel by constructing the walls and ceilings of these areas of black polyethylene.
- E. All negative pressure enclosures shall be smoke tested after initial setup and at the beginning of each work shift.
- F. Ensure that the enclosure walls, floor, and ceiling do not billow or pull out more than 6 inches from the walls or floors to allow for effective cleaning and easy movement of personnel and equipment while inside.
- G. Repair damaged barriers and correct defects as soon as they are discovered. Visually inspect containment barriers at the beginning of each work period. The Government representative may use smoke tube methods to test barrier effectiveness.
- H. Do not commence work until signs are posted, required isolation barriers are erected, and the Contracting Officer or the Government representative has authorized the work to begin. In addition, all equipment such as ladders, scaffolds, HEPA vacuums, air machines, trucks, and other tools and equipment are subject to visual inspection and bulk sampling to ensure that no asbestos debris or contamination is brought onto AEDC from the

contractor's previous jobs. Wrap in two layers of true 6-mil polyethylene sheeting or properly bag any items that have visible debris, label ASBESTOS, and remove from AEDC. Encapsulation of items is not sufficient justification to use contaminated equipment. Items that do not pass visual inspection shall not be cleaned at AEDC.

- I. Turn off all building ventilation air systems during preparation and until the area has passed final visual inspection and final air sampling by the Government representative. Remove all heating, ventilation, and air conditioning system filters before commencing asbestos removal and treat them as asbestos contaminated. Seal all air supply and return openings with true 6-mil polyethylene. Replace filters with new ones following the approved inspection.
- J. Clean the work areas of all visible asbestos debris prior to placing polyethylene sheets or beginning asbestos containment work. Establish critical barriers before beginning clean-up work.
- K. Completely decontaminate all ladders, vacuum cleaners, air machines, and other equipment used during abatement activities prior to removal from the abatement area. Cover all such equipment with true 4-mil polyethylene sheeting and duct tape prior to abatement activity. Seal all openings to air machines with true 6-mil polyethylene prior to their removal from an abatement area and any time they are not in operation. Wrap vacuum cleaner hoses with polyethylene. Seal all open ends of vacuum hoses or intake openings of vacuums with duct tape when not in operation to contain the asbestos. Seal ladder rungs, steps, and sides in polyethylene before use in an abatement area to ensure their complete decontamination following abatement. Clean and completely decontaminate all pump-up sprayers, tools, and equipment following abatement. If they cannot be decontaminated, dispose of them as asbestos material in the AEDC asbestos landfill, which is located approximately 2 miles west of the Avenue E and Sixth Street intersection.

3.2 RESPIRATORY PROTECTION REQUIREMENTS

- A. Establish a respiratory protection program as required by ANSI Z88.2, 29 CFR 1910.134 and 29 CFR 1926.1101. The Government will strictly enforce the OSHA "no facial hair/respiratory policy" for all personnel who wear respirators at any time during the job.
- B. Ensure workers are clean shaven daily immediately preceding their work shift and before wearing respiratory protection.
- C. Provide spectacle inserts to personnel wearing full-face respirators who normally wear spectacles, otherwise they will not be allowed in the containment area. Do not allow contact lenses to be worn in asbestos areas.

3.3 PROTECTIVE EQUIPMENT

- A. Use protective equipment that meets all Government standards for use in asbestos abatement. Use coveralls having headcovers and booties attached.

3.4 LOCAL EXHAUST SYSTEM

- A. Provide a local exhaust system in the asbestos control area in accordance with ANSI Z9.2. Equip exhaust with absolute HEPA filters. When possible, HEPA-filtered air shall be exhausted to the outside of buildings. Local exhaust equipment shall be sufficient to maintain a minimum pressure differential of minus 0.02 inches of water column relative to adjacent unsealed areas and provide a minimum of four complete air changes per hour. Provide continuous 24-hour-per-day monitoring of the pressure differential with an automatic recording instrument. In no case shall the building exhaust system be used as the local exhaust system for the asbestos control area. Filters on vacuums and exhaust equipment shall conform to ANSI Z9.2. Change HEPA filters at least every 700 hours for 12-inch HEPA filters or more often as required to ensure proper filtration of air. Change pre-filters as soon as visible accumulations occur on the filters, and change intermediate filters at least once per shift. If filter loading occurs (i.e., visible accumulations on prefilter), change more often. Conduct air monitoring during asbestos removal to ensure filter integrity and asbestos levels outside the enclosure remain at or below 0.01 f/cc. Provide and install a back-up HEPA air exhaust ventilation system to be used in the event of primary system failure. Do not use a system with a remote filter housing inside gross removal areas.

3.5 COMMUNICATION DEVICES

- A. Do not use any two-way communication devices unless pre-approved by the AEDC Security Forces.

3.6 CONFINED SPACES

- A. Ensure entry into confined spaces is consistent with AEDC Safety Standard B5. Before entering a confined space, make oxygen and Lower Explosive Limit (LEL) measurements using a NIOSH-approved O₂/LEL metering device. While persons are working in a confined space, designate a stand-by person to remain outside who has been trained within the last 12 months in cardiopulmonary resuscitation (CPR) by the American Red Cross or American Heart Association.

3.7 ASBESTOS REMOVAL

- A. General: Comply with the rules of Tennessee Department of Environment and Conservation, Chapter 1200-3-11-.02, and 40 CFR 61. The Government will notify the Tennessee Air Pollution Control Board (ref 1200-3-11-.02 [2][d]1[ii])

and 2). The removal of asbestos insulation from existing piping or other surfaces shall be subject, but not limited, to the following:

1. Require personnel who work with asbestos to use disposable coveralls; disposable head, neck, and shoe coverings; non-porous gloves; eye goggles; and a NIOSH-approved respirator.
 2. Saturate all asbestos materials with wetting agent and ensure the material stays damp during removal. Do not allow asbestos insulation to drop to the floor or ground. Place asbestos in a proper container and lower to the floor or ground as appropriate.
 3. Protect all existing machinery, equipment, floors, and walls from contamination by asbestos waste.
 4. Control the dispersal of asbestos particles through methods such as isolation and wetting of material before removal. Keep a HEPA-filter vacuum on the job site at all times for use in clean-up of asbestos debris and during glove bag removal.
 5. Do not wear protective clothing off the job site or take home for laundering. Provide a decontamination locker room and a clean locker room for personnel required to wear whole-body special clothing. Keep street clothes in the clean locker. While still wearing respirators in the decontamination room, vacuum and remove asbestos-contaminated disposable protective clothing and seal in impermeable bags or containers for disposal. Locate a shower between the decontamination and clean locker rooms and require all employees to shower before changing into street clothes. Filter shower water to 1 micron prior to disposal in a sanitary sewer.
 6. Do not smoke, eat, drink, chew tobacco or gum, or apply cosmetics at the job site. Ensure that workers are fully decontaminated prior to conducting any of these activities.
- B. Small section removal: Use glove bags to remove asbestos material in small sections with two-person teams specifically trained in glove bag procedures. The Government will enforce strict observance of the glove bag techniques described in 29 CFR 1926.1101 and as specified herein.
1. Place polyethylene under the work area.
 2. Wear full body protection (e.g., coveralls, booties, headcovers, and gloves) in addition to respiratory protection.
 3. Turn off ventilation systems located in the area during asbestos removal.
 4. Clean up and seal ventilation openings in the area.
 5. Establish critical barriers by sealing doors and windows or wall penetrations as necessary.
 6. Do not allow asbestos insulation to drop to the floor or ground.
- C. Glove bag requirements: In areas where insulation has caused contamination under the pipe line, pre-clean the work area of all contamination before applying polyethylene worksheet or conducting any repair or glove bag activity.
1. Use true 6-mil-thick transparent polyethylene glove bags.

2. Ensure that the diameter of the pipe insulation does not exceed one-third of the bag's working length.
3. Secure the glove bag with an air-tight seal of duct tape. Place duct tape around the pipe insulation first to form a smooth seal.
4. Ensure the glove bag is sealed by conducting a smoke test. A smoke test is conducted by inserting a smoke tube used in ventilation system analysis through the bag. If smoke leaves the bag, the seal is inadequate; and work will be discontinued until an adequate seal is achieved. Retest the glove bag after each failure.
5. Wrap any damaged pipe insulation, adjacent to the work area or capable of creating asbestos fallout as a result of glove bagging, in at least true 6-mil-thick plastic sheeting and seal tight with duct tape, or seal and repair with insulation mastic. In areas where insulation to be removed has deteriorated and the temporary repair may create a potential fiber release, use HEPA local exhaust ventilation during repair or removal.
6. Saturate all asbestos-containing materials within the glove bag with amended water prior to stripping. When using pump-up sprayers for wetting agents and encapsulants, place the spray wand through the side of the bag and seal holes prior to the start of asbestos removal.
7. Saturate the pipe with amended water after the insulation has been stripped and scrub with a brush to remove all visible asbestos material.
8. Seal any piping insulation ends created by the repair with an EPA-approved encapsulant and an insulation mastic.
9. Use a HEPA vacuum to collapse the glove bag. Seal the vacuum in the glove bag prior to asbestos removal and run continuously during shifting of glove bag.
10. Use negative pressure enclosure with HEPA local exhaust ventilation in areas where removal of badly deteriorated insulation is to occur, regardless of the amount of asbestos to be removed.
11. Double-bag the glove bag and all other asbestos-containing waste for disposal.

D. Floor tile removal requirements:

1. Post warning signs at the entrance to the renovation area.
2. Shut off the building HVAC system during tile removal and subsequent clean-up. Seal ductwork openings with polyethylene sheeting as required in paragraph 3.1I. Establish critical barriers to the work area by sealing doors, windows, and any wall penetration.
3. Conduct no other construction work in the renovation area while removing asbestos tile or during the clean-up of removed tile.
4. Pre-clean the floor tile to be removed of all visible construction debris and dust. This pre-cleaning is not considered asbestos removal unless damaged floor tile is removed during the process.
5. Seal all holes, floor penetrations, and utility tracks found in the floor to prevent asbestos contamination by tile, mastic, or contaminated water.
6. Cover the walls of the floor tile removal area with one layer of true 4-mil polyethylene to a height of 4 feet. Do not damage wall coverings during this process.

7. Remove floor tiles using methods that will not create any visible dust. The preferred method is to wet the floor, cover it with polyethylene, and let the floor remain wet overnight or longer. The water under the plastic should loosen the glue allowing easy dust-free removal of the tile. Use a hand sprayer to mist tiles as they are being removed to further reduce dust. Remove glue that might remain on the floor using a method that does not create dust. If a sanding method is used, it shall be done under wet conditions. Use a HEPA-filtered vacuum to remove any residue left on the floor by wet methods.
 8. Dispose of floor tiles, residue, mops, and rags as asbestos-containing materials in the asbestos landfill. Ensure any solvents used for mastic removal do not result in a residue that is considered to be a hazardous waste as defined by the EPA. Do not place solvents in the AEDC asbestos landfill in a free-liquid state. Dispose of all asbestos-contaminated or asbestos-containing materials in two true 6-mil polyethylene bags especially designed for asbestos disposal. If the floor is mopped with water, treat mop water as asbestos-contaminated, solidify, and place in metal drums. Rinse water used to clean asbestos mastic from surfaces shall not be disposed of in the sanitary sewer system. Do not overload bags to the point that they might rupture. Pack asbestos waste containing sharp ends in a manner that will prevent any puncture of bags. Bagged asbestos floor tile or linoleum shall be disposed of in air-tight metal drums. When using metal drums, ensure they meet the requirements of paragraph 3.10D. Transport waste to the asbestos landfill in a covered truck.
 9. When the odor of solvents used for mastic removal is detected in areas adjacent to removal area, ventilate the removal area using a HEPA-filtered air exhaust system until such odors are no longer detected. While this is occurring, stop all solvent use and general removal until odors are no longer detected in adjacent areas.
 10. Monitor area, personnel, and clearance air in accordance with OSHA and EPA guidelines (see paragraph 3.8) during floor tile removal and document asbestos fiber concentrations.
 11. The Government representative will visually inspect the area prior to job completion. Remove all tile and glue residue from floors prior to inspection. The floor shall be considered clean when mastic and floor tile on all surfaces of the floor have been removed. Clean cracks and holes, 1/16-inch or larger in width or diameter, of all mastic that may be removed using solvents, common utility knife, brushes, and HEPA vacuum without damaging the floor by chipping. Cracks and holes smaller than 1/16-inch shall be considered clean if their surfaces have been cleaned of mastics using solvents, brushes, and HEPA vacuum and shall generally be treated the same as non-cracked surfaces.
 12. Ensure compliance for Class II asbestos as stated in 29 CFR 1926.1101.
- E. Window glazing requirements: Remove windows containing only asbestos glazing compounds by doing the following in addition to the requirements of other applicable sections of this specification.

1. Establish critical barriers to the general work area by sealing doors, wall penetrations, and ductwork vents as appropriate.
 2. Post the asbestos warning signs.
 3. Using duct tape and polyethylene, seal all exposed asbestos materials to prevent fiber release during window removal.
 4. Pre-clean the windows, seals, floor, and ground as necessary to remove asbestos contamination located in these areas. Outside, clean the ground a distance of approximately 3 feet from the building and 2 feet to the left and right of each set of windows to remove ground contamination. Remove visible debris only.
 5. Remove the windows with care. Wrap each in two layers of 6-mil polyethylene, label as asbestos, and dispose of in the asbestos landfill as described in paragraph 3.10.
 6. Protect all existing finishes, furniture, and fixtures.
 7. Coordinate the window removal with the window replacement.
 8. Ensure compliance for Class II asbestos as stated in 29 CFR 1926.1101.
- F. Window caulking requirements: Remove windows containing asbestos caulking compounds by doing the following in addition to the requirements of other applicable sections of this specification.
1. Establish critical barriers to the general work area by sealing doors, wall penetrations, and ductwork vents as appropriate.
 2. Post the asbestos warning signs.
 3. Pre-clean the windows, sills, floors, and ground as necessary to remove asbestos contamination located in these areas. Outside, clean the ground a distance of approximately 3 feet from the building and 2 feet to the left and right of each set of windows to remove contamination. Remove visible debris only.
 4. Construct mini enclosures on the inside and outside of the windows and exhaust to the outside using HEPA filtration machines.
 5. If asbestos glazing compounds are present, seal all exposed asbestos materials to prevent fiber release. Remove caulking compounds using wet methods and HEPA-filtered vacuums. Clean windows of all caulking materials or dispose of the entire window in the asbestos landfill as described in paragraph 3.10.
 6. Protect all existing finishes, furniture, and fixtures.
 7. Coordinate the window removal with the window replacement.
 8. Ensure compliance for Class II asbestos as stated in 29 CFR 1926.1101.
- G. Ventilation ductwork removal requirements: Remove ventilation ductwork, which is insulated with a non-asbestos material held in place by asbestos-containing glue or mastic, by doing the following in addition to the requirements of other applicable sections of this specification and 29 CFR 1926.1101.
1. Establish critical barriers to the general work area by sealing doors, windows, wall penetrations, and ductwork vents as appropriate.
 2. Post the asbestos warning signs.
 3. Place a true 6-mil polyethylene worksheet under the work area.

4. Carefully wet the insulation mastic and the wrap the ductwork with one layer of true 6-mil polyethylene.
5. When cutting a duct in sections, strip insulation and mastic from the area of the cut using wet methods and seal the edges of the insulation and mastic before cutting. Take care to prevent mastic fallout from the duct due to vibration caused by cutting.
6. After removing the duct from the ceiling area, wrap the duct with a second layer of true 6-mil polyethylene and label for disposal.
7. Clean any residue mastic remaining on the floor, roof deck, duct hangers, or ceiling frames.
8. Ensure compliance for Class II asbestos as stated in 29 CFR 1926.1101.

3.8 AIR MONITORING: Monitor airborne concentrations of asbestos fibers in accordance with 29 CFR 1926.1101 and as specified below:

- A. Monitoring during asbestos work: Provide personnel and area monitoring and establish an 8-hour time-weighted average and 30-minute excursion level concentration during the first exposure to airborne asbestos to document exposure levels and determine respiratory protection requirements. Thereafter, when the same type of work is being performed, provide area monitoring once per work shift inside the asbestos control area, outside the entrance to the asbestos control area, and at the exhaust opening of the local exhaust system. Due to other areas of the building being occupied during asbestos removal, collect samples from all sides of the work area to verify air quality outside the containment. This includes sampling on the second floor above the asbestos work area. Sampling shall be done each shift. If monitoring outside the asbestos control area shows airborne concentrations above 0.01 f/cc, stop all work, notify the Government representative immediately, and correct the condition causing the increase. Provide results of sampling to the Contracting Officer as soon as possible following collection of the sample. A primary calibration standard is the standard of choice. However, a secondary standard may be used if a calibration curve for that standard is on-site in the field with the secondary standard and the curve compared to a primary standard within 3 months of the sample collection date. Conduct air sampling following the current OSHA Sampling Reference Method, which includes field calibration of sample pumps immediately before and after air sampling.
- B. Monitoring after final clean-up: Provide area monitoring of asbestos fibers and establish a quality level of less than 0.01 f/cc after final clean-up but before removing the enclosure of the asbestos control area. If any of the final samplings indicates a higher value, take appropriate action to re-clean the area and repeat the monitoring. Provide sample results to the Contracting Officer prior to removal of any enclosures or barriers.
- C. Provide the results of all air samples as soon as possible following collection and analysis. Include the location of their collection (for example, area [where], personnel [who]), sample number, start and stop times, dates of

collection, duration of sampling, flow rate in liters per minute, sample volume, total fiber count, detection limit of the analysis and airborne fiber concentration in fibers per cubic centimeter of air, name of the laboratory, and name of the person analyzing the samples. Make field notes used at the job site during sample collection available at any time to the Government representative upon request.

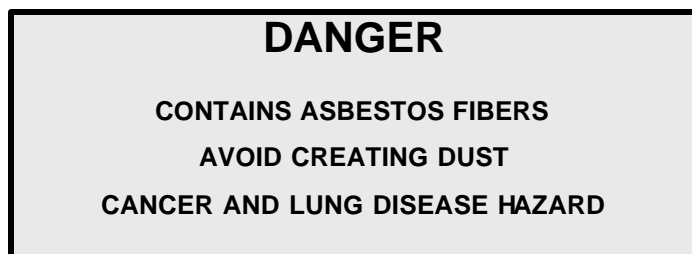
- D. Should you analyze bulk samples, use a laboratory accredited by NIST. Air samples shall be analyzed by a laboratory which is in full compliance with the OSHA Reference Method and participates in the required inter-laboratory quality assurance program. Any persons analyzing these samples shall have attended the required NIOSH- and EPA-approved courses and shall have been determined proficient by successful participation in a NIOSH-PAT (air) or NIST program within the last year. This proficiency shall remain current throughout the course of the project. Return bulk samples to AEDC for disposal.

3.9 VENTILATION

- A. In a non-gross removal area, ventilate the local areas with a HEPA-filtered air exhaust ventilation system during clean-up of areas greater than 400 square feet or when gross asbestos contamination presents such a hazard to warrant the use of a HEPA local exhaust system to control the hazard. See paragraph 3.1K for clean-up in a gross removal area.

3.10 DISPOSAL

- A. Seal asbestos-contaminated material, disposable coveralls, disposable protective equipment, polyethylene, wood, and all other material used for enclosures and scrap in a clear true 6-mil sealed impermeable bag. HEPA vacuum all trapped air from each disposal bag before sealing and place in another true 6-mil labeled, sealed impermeable bag. Bags filled or rebagged at the asbestos landfill do not have to be HEPA vacuumed (see subparagraph C). Label the outer bag with the following warning:



- B. Capture water and fluids used in wet method control and cleaning, and place in labeled, sealed impermeable containers. Label the containers with the same warning required in paragraph 3.10A. Filter water through 1-micron filters before allowing water to pass to a sanitary sewer. Do not place free liquids in the AEDC asbestos landfill.

- C. Dispose of all asbestos waste in the AEDC asbestos landfill. Coordinate times of delivery with the Government representative (normally from 7 am to 1 pm, Monday through Friday). When landfill conditions preclude adequate covering of asbestos, disposal will not be permitted. This determination will be made by the Government representative. These conditions will include, but are not limited to, excessive moisture in the landfill caused by the weather. When this condition occurs, the asbestos will be stored at AEDC at the contractor's expense until the Government grants disposal authority. Do not dispose of asbestos material in any area other than the asbestos landfill. Remove and dispose of all asbestos dust particles and waste generated during each work period at the end of each work period. Place bagged waste not taken to the landfill at the end of the shift in secure areas, such as a locked panel truck, prepared for disposal as indicated in paragraph 3.11.
- D. Place asbestos materials, which contain sharp edges or are too heavy to be placed in true 6-mil polyethylene bags, in clean, new, or reconditioned, practically air-tight metal drums. Reconditioned drums are drums which have been emptied as specified in 40 CFR 261 and repainted inside and out.
- E. Do not place any hazardous waste, as defined in 40 CFR 261, in any AEDC landfill. Where hazardous waste is generated or removed, follow the procedures given in AEDC Safety Standard E18. Coordinate with the Government representative in completing Forms GC-565 and GC-1337.
- F. All users of the asbestos landfill are required to obtain an AEDC Disposal Permit. (Refer to AEDC Safety Standard E7 for permitting procedure and permit requirements.)
- G. Complete Form GC-1622, AEDC Asbestos Landfill Operators Log and Shipper's Log, for each load of asbestos waste. Form GC-1622 will be provided by the Government representative.
- H. Only properly containerized, labeled, and adequately wet asbestos accompanied by a completed Form GC-1622 and an AEDC Disposal Permit shall be transported to or disposed of in the asbestos landfill.

3.11 TRANSPORTATION

- A. Transport properly bagged and identified asbestos waste in a metal panel truck or trailer which is prepared as follows:
 - 1. Bed lined with three layers of true 6-mil polyethylene which overlap walls by at least 12 inches; line the walls with two layers of true 4-mil polyethylene; and line the doors to the enclosed bed lined with two layers of true 4-mil polyethylene.
 - 2. Seal the truck or trailer to prevent any water or contamination leakage.
 - 3. Equip the doors to the lined enclosure with a security lock.

- B. The truck or trailer will be inspected by the Government representative before asbestos is loaded and after disposal.
- C. When transporting asbestos on the open highway, follow current Department of Transportation regulations.

3.12 SEALING

- A. Reseal any asbestos material that is not in the job scope for removal but is exposed as part of this work. Seal with a Government-approved bridging encapsulant and insulation mastic to contain and prevent future damage of the asbestos. If outside, ensure material used will withstand weathering.

3.13 SAFETY

- A. Ensure the safe passage of persons around the area of demolition. Conduct operations to prevent injury to personnel and damage to existing equipment and structures. Minimize the generation and spread of dust and flying particles.

3.14 HAZARD COMMUNICATIONS

- A. Maintain and implement a written Hazard Communications Program as required by 29 CFR 1910.1200 and AEDC Safety Standard A9. Ensure all employees and anyone else involved with the abatement job are familiar with the program and its location. Ensure all other requirements outlined in AEDC Safety Standard A9 are met.

3.15 UTILITIES

- A. Do not interrupt existing utilities or commence power outages without written permission from the Contracting Officer or the Government representative. Obtain an AF Form 103, BCE Work Clearance, from the Government representative prior to interrupting utilities. Do not remove asbestos from active steam or electrical lines. Wait for appropriate utility outages. Provide backflow prevention devices as required to prevent cross-contamination of water supplies.

3.16 GENERAL CLEAN-UP

- A. Remove dust, dirt, and debris caused by demolition operations from adjacent structures and improvements. Return adjacent areas to their condition prior to the start of the work.

3.17 LABELING

- A. Stencil new and replaced insulation with the word "NON-ASBESTOS," in accordance with ANSI A13.1, at the edges of replaced sections. Indicate the

direction of replacement with arrows using a 1-inch stripe to indicate the boundaries. Place the word "NON-ASBESTOS" at intervals not exceeding 25 feet using a highly visible paint.

- B. Place labels identifying piping systems (e.g., 30 lb. steam, raw water, heated potable water) as appropriate for newly insulated piping systems.

3.18 DEBRIS DISPOSAL

- A. Transport debris, rubbish, waste, and other non-asbestos materials resulting from demolition from the site to the construction landfill which is located approximately 2 miles west of the Avenue E and Sixth Street intersection. Do not place edibles or garbage in the construction landfill; use existing dumpster boxes.
- B. Dispose of all material contaminated by asbestos in the asbestos landfill as described in paragraph 3.10.

3.19 VISUAL INSPECTIONS

- A. Visually inspect the work area after pre-cleaning and before placing any polyethylene sheeting. Re-clean and inspect any area where cleaning has not been adequately done before placing polyethylene sheeting. Inspect polyethylene enclosures for adequacy prior to removing any asbestos. Do not start abatement procedures prior to release by a Government industrial hygienist who will visually inspect the area for cleanliness and enclosure adequacy.
- B. Assist in the visual inspection of all areas (enclosure areas cleaned, disposal bags, drums, trucks, and equipment used in asbestos removal) as requested by the Government representative. Include the opening of drums and bags or any other inspection activity.

3.20 ASBESTOS ABATEMENT COMPLETION

- A. Do not remove protective barricades or enclosures until the Government representative concurs in writing. The Government may conduct independent, aggressive air monitoring at the conclusion of the removal operation to determine air quality. A reading of not more than 0.01 f/cc of air is required before barricades and enclosures shall be removed. The Government representative will visually inspect the affected surfaces for residual asbestos material and accumulated dust, and the contractor shall re-clean all areas showing dust or residual asbestos materials. If re-cleaning is required, monitor the airborne asbestos concentrations after re-cleaning. Remove the decontamination facility from the area following the final visual inspection and upon concurrence by the Government representative. Encapsulate interior of polyethylene walls, ceiling, floor, pipe surfaces, and other surfaces where asbestos has been removed following visual inspection. Keep the area

sealed, barriers intact, and HEPA-filtered air exhaust ventilation in operation until the results of final air samples are received. The Government representative will visually inspect the general work area following enclosure or barrier removal to ensure the work area has been adequately cleaned and to ensure that no damage has been done to buildings or equipment.

END OF SECTION

PART 1 GENERAL**1.1 SUMMARY**

- A. This section applies to the removal and disposal of lead-containing materials and other heavy metals (barium, cadmium, silver, mercury, and chromium).

1.2 CODES AND STANDARDS**A. AEDC Safety Standards:**

1. A6 User and Subcontractor Safety, 1996.
2. A9 Hazard Communication, 1996
3. B1 Work Clearances, 1998.
4. E17 Oil and Hazardous Substances Spill Response, 2000.
5. E18 Chemical and Petroleum Products Waste Management, 1998.
6. E19 Lead and Heavy Metals, 1997.

B. American National Standards Institute (ANSI) Standards:

1. Z9.2-91 Fundamentals Governing the Design and Operation of Local Exhaust Systems.
2. Z88.2-92 Respiratory Protection.

C. Code of Federal Regulations (CFR):

1. 29 CFR 1910.134 Respiratory Protection, 2000.
2. 29 CFR 1910.1200 Hazard Communication, 2000.
3. 29 CFR 1926.55 Gases, Vapors, Fumes, Ducts, and Mists, 2000.
4. 29 CFR 1926.57 Ventilation, 2000.
5. 29 CFR 1926.62 Lead Standard, 2000.
6. 40 CFR 260 Hazardous Waste Management Systems: General, 2000.
8. 40 CFR 261 Identification and Listing of Hazardous Waste, 2000.
9. 40 CFR 262 Generators of Hazardous Waste, 2000.
10. 49 CFR 172 Department of Transportation (DOT) Regulations for Use of Hazardous Materials Tables and for Communication, 2000.
11. 49 CFR 178 DOT Specifications for Packaging, 2000.

D. Environmental Protection Agency (EPA) Document:

1. SW-846 Proposed Sampling and Analytical Methodologies for Additions to Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, 1984.

E. Steel Structures Painting Council (SSPC) Standard:

1. Guide 7-95 Guide for the Disposal of Lead-Contaminated Surface Preparation Debris.

F. Underwriters Laboratories, Inc. (UL) Standard:

1. 586-99 Safety High-Efficiency, Particulate, Air Filter Units.

1.3 DEFINITIONS

- A. Action level: Employee exposure, without regard to use of respirators, to an airborne concentration of lead of 30 $\mu\text{g}/\text{m}^3$ averaged over an 8-hour period. As used in this section, "30 $\mu\text{g}/\text{m}^3$ " refers to the action level.
- B. Area monitoring: Sampling of lead concentrations within the lead-control area and inside the physical boundaries which is representative of the airborne lead concentrations which may reach the breathing zone of personnel potentially exposed to lead.
- C. Change rooms and shower facilities: Rooms within the designated physical boundary around the lead-control area equipped with separate storage facilities for clean protective work clothing and equipment and for street clothes which prevent cross-contamination.
- D. Clearance level: Prior to the moving or removal of enclosures used for lead abatement, air samples will be taken by the Government representative to ensure that airborne levels of lead are at or below 3 $\mu\text{g}/\text{m}^3$. In addition, a detailed visual inspection will be conducted by the Government representative for all surfaces and equipment in the containment or control area. Surfaces include any portion of the containment including walls, ceilings, and floors, scaffolds, and any equipment or objects that are present in the containment or that have been used in the containment. The inspection will be conducted by wiping a clean cloth across all surfaces and inspecting the cloth for evidence of any dust. If any dust is found on the cloth, the contractor shall re-clean the entire containment until a detailed inspection is passed. All dust will be assumed to be lead- or heavy-metal contaminated. When enclosures are not required, inspection of the work area will be conducted to ensure adequate decontamination of the area. This method will be used before moving or removing containments or enclosures. Before containments are removed from AEDC, wipe and/or microvac samples will be collected from representative surfaces to determine if the containments have been cleaned to a level of 500 $\mu\text{g}/\text{ft}^2$ or less. If any one sample exceeds 500 $\mu\text{g}/\text{ft}^2$, then the entire containment shall be re-cleaned.

- E. Decontamination room: Room designated for removal of contaminated personal protective equipment (PPE).
- F. Designated lead-abatement supervisor: A person who has attended any 3- to 5-day lead-abatement course taught in the United States. The person shall be knowledgeable of Occupational Safety and Health Administration (OSHA), Environmental Protection Agency (EPA), and other Government regulations.
- G. Eight-hour time weighted average (TWA): Airborne concentration of lead averaged over an 8-hour workday to which an employee is exposed.
- H. Grit blasting: Remove paint with recyclable steel grit or recyclable steel grit embedded in a synthetic open-cell polymer sponge.
- I. High-efficiency particulate air (HEPA) filter equipment: HEPA-filtered vacuuming equipment with a UL 586 filter system capable of collecting and retaining lead-contaminated paint dust. A high-efficiency particulate filter means it is 99.97 percent efficient against 0.3-micron-size particles. This equipment may be containment exhaust systems or hand held paint removal equipment such as peeners, needle-guns, grinders, or sanders.
- J. Lead: Metallic lead, inorganic lead compounds, and organic lead soaps.
- K. Lead-control area: An enclosed area or structure with full containment to prevent the spread of lead dust, paint chips, or debris of lead-containing paint-removal operations. The lead-control area is isolated by physical boundaries to prevent unauthorized entry of personnel.
- L. Lead permissible exposure limit (PEL): Fifty $\mu\text{g}/\text{m}^3$ as an 8-hour TWA as determined by 29 CFR 1926.62. If an employee is exposed for more than 8 hours in a work day, the PEL shall be determined by the following formula:
$$\text{PEL } (\mu\text{g lead}/\text{m}^3) = 400/\text{No. hrs. worked per day}$$
- M. Microvac: Alternate sampling method for surfaces that are not conducive to wipe sampling. Sampling is conducted using a 37mm air sampling cassette with 0.8 micron filters at a flow rate of approximately 4 liters per minute. Samples are vacuumed from a 6 in² area unless conditions require a smaller or larger sample area. Results will be reported in $\mu\text{g}/\text{ft}^2$.
- N. $\mu\text{g}/\text{m}^3$: Micrograms per cubic meter of air (refers only to lead in this document).
- O. $\mu\text{g}/\text{ft}^2$: Micrograms per square foot of surface (refers only to lead in this document).

- P. Personal monitoring: Sampling of lead concentrations within the breathing zone of an employee to determine the 8-hour TWA concentration in accordance with 29 CFR 1926.62. Samples shall be representative of the employee's work tasks. Breathing zone shall be considered an area within a hemisphere, forward of the shoulders, with a radius of 6 to 9 inches and the center at the nose or mouth of an employee.
- Q. Physical boundary: Area physically roped or partitioned around an enclosed lead-control area or area where HEPA filtered hand or power tools are used or chemical paint removal is being conducted. The barriers are placed to limit unauthorized entry of personnel. As used in this section, "inside boundary" shall mean the same as "outside lead-control area but within the roped-off area." In areas where enclosures are not used, this is the area where lead abatement work is being conducted.

1.4 SUBMITTALS

- A. Evidence satisfactory to the Contracting Officer that the firm performing lead abatement has at least one designated employee on site during all abatement activity who has attended a lead-abatement course taught in the United States and who is knowledgeable in all aspects of lead abatement. Show this by course certification and description of past lead-abatement experience which includes a list of previous clients and a resume. Have physically on each individual job site at least one such designated supervisor directly responsible for the work whenever any phase of the project is in progress. Multiple enclosures being worked at the same time shall require individual lead-abatement supervisors responsible for each enclosure.
- B. Written certification that all employees involved in lead abatement have received training and medical examinations as required by 29 CFR 1926.62. Certification includes respirator fit-test and training records and a copy of the respiratory protection program. Include with the certifications, dates of the most recent training, medical examinations, and a physician's statement indicating that workers are physically able to perform lead-abatement work and use the required respiratory and general body protection. Provide this information for all personnel including management and any air-monitoring personnel on the job site before their first entry within the job site. Training shall be accomplished prior to the time of initial job assignment. Keep the job information current for all employees during all phases of the job.
- C. Any citation or notice of violation from any Government agency issued as a result of work performed under this contract or any contract engaged in during the last 3 years. Submit a brief explanation of any cited incident. If none have been received, submit certification to that effect.
- D. Environmental, health, and safety plan that addresses all environmental, health, and safety aspects of the job. Submit this plan within 30 calendar

days after award of the contract and before any field work begins. The plan shall include the following information:

1. Identification of hazardous waste associated with the work.
 2. Estimated quantities of wastes and/or hazardous wastes to be generated and disposed of.
 3. Names and qualifications (experience and training) of personnel who will be working on site with hazardous waste.
 4. List of the waste-handling equipment to be used in performing the work, to include cleaning, volume-reduction, and transport equipment.
 5. Spill prevention, containment, and clean-up contingency measures to be implemented. Reference AEDC Safety Standard E17.
 6. Work plan and schedule for waste containment, removal, and disposal. Waste shall be cleaned up and containerized daily.
 7. Methods to control fugitive air emissions.
 8. Methods to control employee exposure to lead during removal.
 9. Methods to ensure safety including a lockout/tagout plan; job safety analysis; tool box safety meeting minutes; accident reports and investigations; lead-testing data/certification; fall protection systems; shop drawings; procedures for disposing waste, scrap, and excess materials; and procedures for work involving transportation or disposal of hazardous waste. The plan shall address all other environmental, health, and safety concerns associated with the job. The plan shall also include fire safety plan and procedures for addressing other work area emergencies in compliance with 29 CFR 1926.55, and a hazardous waste management plan in accordance with 40 CFR 260 and with applicable requirements of federal and local hazardous waste regulations.
- E. A copy of the hazard communications program and certification that all employees have been trained concerning the hazard communications standards and the written program in accordance with 29 CFR 1910.1200 and AEDC Safety Standard A9.
- F. A list of products to be used and a Material Safety Data Sheet (MSDS) for each. Products include, but are not limited to, aerosol sprays of any kind, wetting and cleaning agents, fuels, solvents, paints, etc. MSDS's shall be kept in a notebook and indexed for easy reference. This MSDS notebook shall remain available to all employees on the job site at all times.
- G. A detailed job-specific plan of the work procedures to be used in the removal of lead paint. The plan shall include a sketch showing the locations, size, and details of lead-control areas and the location and details of decontamination rooms, change rooms, shower facilities, and mechanical ventilation systems. Include eating, drinking, smoking, and restroom procedures; interface of trades; sequencing of lead-related work; collected wastewater (to include shower water) and paint debris disposal plan; air sampling plan; respirators; protective equipment; and a detailed description of the method of containment of the operation to ensure that airborne lead concentrations of

3 µg/m³ are not exceeded outside the lead-control area. Include air sampling, training, strategy, sampling methodology, frequency, duration of sampling, and qualifications of air-monitoring personnel in the air-sampling portion of the plan. Obtain approval of the plan prior to the start of paint-removal work.

- H. Air and substrate sampling reports.
- I. Testing laboratory qualifications including the name, address, and telephone number of the testing laboratory selected to perform the monitoring, testing, and reporting of airborne and substrate concentrations of lead. The laboratory shall be accredited by the American Industrial Hygiene Association (AIHA). Provide AIHA documentation along with date of accreditation/re-accreditation. Samples collected to determine if materials are hazardous waste shall be analyzed by a laboratory qualified to conduct such analysis following Environmental Protection Agency Document SW-846. Provide split samples of any materials or media to the Government as requested for Government analysis.
- J. Air-monitoring results submitted within 24 hours following the monitoring, signed by the person performing the air monitoring, the employee who analyzed the sample, and the designated site superintendent responsible for the lead-abatement operation. See paragraph 3.2.B.3 for additional information.
- K. A list of all equipment, including water, air filters, and respirators to be used, and manufacturer's literature showing that the equipment and material meet all EPA, OSHA, and ANSI standards for use in lead-abatement activities. Include certification that vacuum- and air-filtration devices are filtered with HEPA filters. Include operating instruction for paint-removal equipment.
- L. Equipment rental notifications (see paragraph 1.5C).
- M. Shower water sample test results.

1.5 EQUIPMENT

- A. Respiratory protection requirements: Establish a respiratory protection program as required by ANSI Z88.2, 29 CFR 1910.134 and 29 CFR 1926.62. The Government will strictly enforce the OSHA "no facial hair/respiratory policy" for all personnel who wear respirators at any time during the job.
 - 1. Ensure workers are clean shaven daily immediately preceding their work shift and before wearing respiratory protection.
 - 2. Provide spectacle inserts to personnel wearing full-face respirators who normally wear spectacles; otherwise, spectacles shall not be worn in lead-abatement areas.

- B. Special protective clothing: Furnish personnel who will be exposed to lead-contaminated dust with appropriate disposable protective whole-body clothing, head coverings, gloves, and foot coverings. Use coveralls having head covers and booties attached. Furnish appropriate disposable plastic or rubber gloves to protect hands. Reduce the level of protection only after obtaining concurrence from the Government representative.
- C. Rental equipment notification: If rental equipment is to be used during lead-containing paint handling and disposal, notify the rental agency in writing concerning the intended use of the equipment. Furnish a copy of the written notification to the Contracting Officer (see paragraph 1.4L).
- D. Vacuum and negative air machine filters: UL 586-labeled HEPA filters.
- E. Decontamination: Completely decontaminate all ladders, vacuum cleaners, air machines, and other equipment used during abatement activities prior to removal from the abatement area. If they cannot be decontaminated, then dispose of them as hazardous waste.
- F. Condition: Clean all equipment used at non-AEDC job sites prior to arrival at AEDC. Any contaminated equipment identified during inspection of incoming vehicles shall be removed from AEDC until cleaned. Any such equipment shall not be cleaned at AEDC. Do not remove any equipment used at AEDC that has not been decontaminated and inspected by the Government representative. All equipment and other articles are subject to inspection by Government representatives upon arrival or exit from AEDC. Contaminated equipment identified on out-going vehicles will be impounded by the Government until the contractor conducts adequate decontamination procedures.

PART 2 PRODUCTS

2.1 ABRASIVE MATERIALS (If applicable)

- A. Abrasive blasting materials shall meet the requirements as specified in the paint schedule under "Surface Preparation."
- B. Limits on the composition of abrasive materials: The soluble metal content and the total metal content shall not exceed values which would cause a material to be classified as a hazardous waste as defined in 40 CFR 261.

PART 3 EXECUTION

3.1 PROTECTION

- A. Notification: Notify the Government representative 30 days prior to the start of any paint-removal work.

B. Lead-control area requirements:

Establish a lead-control area by completely enclosing the area or structure where lead-containing paint-removal operations are to be performed or isolate using barrier ropes and signs if containment is not required.

2. When enclosures are not required, place polyethylene sheeting on the ground or floor of the work area and out from the building a distance of at least twenty feet. Cover non-moveable objects with protective covering such as polyethylene. Close and tightly lock doors and windows when working near doors or windows. Protect brick and walls from contamination and remove prior dust and debris by HEPA vacuum and wet wiping. If doors and windows will not tightly close, seal with polyethylene from the inside of the building. If storm windows must be removed to allow repainting of windows, wet wipe and HEPA vacuum the entire storm window (both sides) to remove any lead contamination.
3. When building occupants are allowed to remain in the premises provide a safe, lead free access to and from the building during the work and at the end of the day. Provide adequate security to the work area and equipment to prevent any hazard to the area occupants.
4. Contain removal operations by the use of a negative-pressure full-containment system. Also see paragraph 3.1.I.
5. Enclosures used to control lead emissions shall consist of the lead-abatement work area, and a decontamination unit for personnel, consisting of a dirty equipment room, a shower equipped with hot and cold running water, and a clean change room for workers. A separate decontamination chamber shall be constructed for equipment decontamination and the safe passage of hazardous wastes from the work area to the outside. Removal of contaminated dust-collecting filters from the recycling abrasive blasting and vacuuming machines shall be accomplished in a manner to prevent the contaminated dust from entering the environment. All personnel assigned to changing filters and cleaning the machinery shall be fully clothed with approved protective clothing and equipment. The clean room shall be equipped with lockers where clean respirators and street clothes are stored. No contaminated articles shall enter the clean room. Contaminated articles shall remain in the work area until cleaned or disposed of as hazardous waste. The decontamination units shall be constructed contiguous to the work area (enclosure), and the shower shall be constructed in a manner that requires the worker to pass from the dirty room through the shower stall into the clean room.
6. Filter shower water through a 1-micron filter or other filter system that will result in equivalent water filtration. Collect water and sample to determine if lead levels in the water are below 100 ppb if tested by a qualified laboratory or 50 ppb if tested by an approved field kit. If levels are below these concentrations, then the water may be discharged into the sanitary sewer. All water shall be collected and sampled before discharge using either a field measuring kit as described below or the results from a qualified laboratory. Sample results from the qualified laboratory shall be submitted to the Contracting Officer for approval prior

to discharging the water. The Government representative may collect and test duplicate samples to ensure the integrity of the qualified laboratory performing the analysis. Field analysis conducted using portable test kits will be approved by the Government industrial hygienist prior to use. Colorimetric test kits such as CHEMetrics, Inc., Cat. No. K-8350, are such kits. Any water tested using field kits that indicates lead levels above 50 ppb shall be re-filtered and re-tested until field measurements are below 50 ppb or the water has been found to be less than 100 ppb using laboratory testing from a qualified laboratory. Sample results from the qualified laboratory shall be submitted to the Contracting Officer for approval prior to discharging the water. If field analysis is used, a Government representative will be present during all testing and field analysis. The holding tank used for the collection of contaminated water will be locked and unlocked by the Government representative to prevent the release of contaminated water to the environment before adequate filtering. The contractor shall provide the means of locking the tank; however, the Government representative will provide the lock.

7. Enclosures used for lead abatement shall be constructed of materials strong enough to withstand environmental elements (i.e., wind, rain, and snow) when outside. The containment shall comply with a Class 1 containment system as described in SSPC Guide 7 (CON). The containment shall be made of impermeable walls with rigid or flexible framing, fully sealed joints, airlock entryways, and HEPA-filtered negative air achieved by forced air flow (verified by instrument monitoring). Air flow in the containment shall be maintained at a pressure differential of minus 0.02 inch of water. Air flow in the containment shall be maintained at a minimum of 100 ft/min for the cross draft ventilation and at least 60 ft/min for the down draft ventilation. Construct hygiene facilities for decontamination of workers and equipment similar to the main containment. Construct doors so that flaps completely isolate the enclosure in the event of air exhaust failure and allow easy access for personnel and equipment. The clean room shall be large enough to accommodate at least three workers at any one time. Prevent direct viewing into the shower, clean room, or dirty room by other personnel by constructing the walls and ceiling of these areas of black polyethylene or similar material. Provide detailed specifications, drawings, and load calculations of containment structure for 100 percent containment of lead emissions, grit, and dust. If the containment is to be used for abrasive blasting, blast shields shall be used to protect the outside walls of the containment from damage by blast media.
- C. Protection of existing work to remain: Perform paint removal work without damage or contamination of adjacent areas. Where existing work is damaged or contaminated, restore work to its original condition or better.
 - D. Boundary requirements: Provide physical boundaries around the lead-control area by roping off the area. Ensure that airborne concentrations of lead will not exceed 3 µg/m³ outside the lead-control area or enclosure.

- E. Change room and shower facilities: Provide clean change rooms and shower facilities within the physical boundary around the designated lead-control area in accordance with requirements of 29 CFR 1926.62 and as outlined in paragraph 3.1.
- F. Mechanical ventilation system:
 - 1. Use adequate ventilation to control personnel exposure to lead in accordance with 29 CFR 1926.57.
 - 2. Local exhaust system: Provide a local exhaust system in the lead-abatement area (enclosure) in accordance with ANSI Z9.2. Equip exhaust with absolute HEPA filters. HEPA-filtered air will be exhausted to the outside of buildings when work is conducted inside buildings. Local exhaust equipment shall be sufficient to maintain a minimum pressure differential of minus 0.02 inches of water column relative to adjacent unsealed areas. Provide continuous 24-hour-per-day monitoring of the pressure differential with an automatic recording instrument. Filters on vacuums and exhaust equipment shall conform to ANSI Z9.2. Change pre-filters and HEPA filters often enough to ensure that lead concentrations at the exhaust are at or below 3 µg/m³. Provide and install a back-up HEPA air-exhaust ventilation system to be used in the event of primary system failure. Do not use a system with a remote filter housing inside the lead-removal area.
- G. Personnel protection: Personnel shall wear and use protective clothing and equipment as specified herein. Eating, smoking, and/or drinking are not permitted in the lead-control area. No one shall be permitted in the lead-control area unless they have received appropriate training and protective equipment.
- H. Warning signs: Provide warning signs at approaches to lead-control areas. Locate signs at such a distance that personnel may read the sign and take the necessary precautions before entering the area. Signs shall comply with the requirements of 29 CFR 1926.62.
- I. During building renovations where abrasive blasting is not used and paint must be removed by other means, such as HEPA-shrouded mechanical removal equipment, critical barriers and polyethylene enclosures may be used. The requirement for showers and HEPA negative pressure exhaust shall be dependent on air concentrations. If air concentrations are below the action level for lead, then showers shall not be required. Hand and face washing facilities shall be required. Submit methods of removal and control as required in paragraph 1.4.D. If work is done outside, then air concentrations within the work area shall be within acceptable limits as indicated in paragraph 3.1.D. above. Submit methods of removal and control as required in paragraph 1.4.D.

3.2 WORK PROCEDURES

- A. Perform removal of lead-containing paint in accordance with the approved lead-containing paint removal plan. Use procedures and equipment required to limit occupational and environmental exposure to lead when lead-containing paint is removed in accordance with 29 CFR 1926.62 and 40 CFR 262, except as specified herein. (Dispose of removed paint chips and associated waste in compliance with federal and local requirements.) The hazardous waste shall be properly drummed and labeled as required by 49 CFR 172 prior to being moved by the contractor to an accumulation point, which is within one mile of the job site (see paragraph 3.9F).
 - 1. Personnel exiting procedures: Whenever personnel exit the lead-controlled area, they shall perform the following procedures and shall not leave the work place wearing any clothing or equipment worn during the work day:
 - a. Vacuum themselves.
 - b. Remove protective clothing in the decontamination room, and place them in an approved impermeable 6-mil polyethylene disposal bag.
 - c. Shower.
 - d. Change to clean clothes prior to leaving the physical boundary designated around the lead-contaminated job site.
- B. Air monitoring: Monitor airborne concentrations of lead in accordance with 29 CFR 1926.62 and as specified below:
 - 1. Monitoring during lead-abatement work: Provide personnel and area monitoring and establish an 8-hour TWA during the first exposure to airborne lead to document exposure levels and determine respiratory protection requirements. Provide continuous area monitoring during each work shift inside the lead-control area, outside the entrance to the lead-control area, and at the exhaust opening of the local exhaust system. If monitoring outside the lead-control area shows airborne concentrations above 3.0 $\mu\text{g}/\text{m}^3$, stop all work, notify the Government representative immediately, and correct the condition causing the increase. Conduct air sampling following OSHA and NIOSH guidelines which includes field calibration of sample pumps immediately before and after air sampling.
 - 2. Collect personal air-monitoring samples on employees who are anticipated to have the greatest risk of exposure. In addition, take air-monitoring samples on at least 25 percent of the work crew or a minimum of two employees, whichever is greater, during each work shift.
 - 3. Submit the results of all air samples taken in support of the contract within 10 days following their collection. Include the location of their collection (for example, area [where], personnel [who], sample number, start and stop times, dates of collection, duration of sampling, flow rate in liters per minute, sampling volume, total lead concentration in $\mu\text{g}/\text{m}^3$, detection limit of the analysis, TWA of the representative employee's exposure, name of the laboratory, and name of the person collecting the sample and analyzing the samples). This information shall be submitted

in a formal report to the Contracting Officer. Within 24 hours of sample collection, make the sampling available for the Government representative's review. These may be laboratory reports or rough draft field data. Make field notes used at the job site during sample collection available at any time to the Government representative. Notify the Contracting Officer immediately of exposure to lead at or in excess of 3 $\mu\text{g}/\text{m}^3$ outside the lead-control area.

4. Monitoring after final clean-up: Provide area monitoring of lead concentrations and establish an air quality level of 3 $\mu\text{g}/\text{m}^3$ or less after final clean-up. Before moving or removing the enclosure from the lead-abatement control area, the Government representative will conduct a visual inspection of the area to determine its cleanliness. Once the visual inspection has been passed, the Government representative will collect clearance air samples to determine lead air concentrations. If the air samples indicate levels above 3 $\mu\text{g}/\text{m}^3$, then the contractor shall re-clean the enclosure, and the visual inspection and clearance air sampling shall be repeated. This shall continue until an inspection is passed and a clearance sample is obtained. The contractor shall assist the Government representative to ensure adequate inspection of all surfaces of the enclosure and work areas. See paragraph 1.3.D.

- C. Once the visual inspection and air samples meet necessary requirements, remove the enclosure.

3.3 LEAD-CONTAINING PAINT REMOVAL

- A. Comply with the applicable procedure in Annex B, AEDC Safety Standard E19 and the following: Manual or power sanding/grinding of interior and exterior surfaces is not permitted unless accomplished in enclosure or done so using proper barriers, signs, HEPA vacuum attachments on equipment, and wet methods. Also see paragraph 3.1.B. and I. Remove paint within the areas as required to allow cutting or painting as identified under scope of lead abatement in section 1.1B. on the drawings and in the paint schedule in order to completely expose the substrate. Take whatever precautions are necessary to minimize damage to the underlying substrate if painting.
 1. Mechanical paint removal and blast cleaning: Perform mechanical paint removal and blast cleaning in lead-control areas using negative-pressure full-containment with HEPA-filtered exhaust. Collect paint residue and spent grit (used abrasive) from blasting operations for disposal in accordance with CFR and local requirements.
 2. Abrasive blasting and vacuum filtering system: The system used to collect residue paint and grit blast shall be contained in a HEPA-filtered exhausted enclosure to ensure that the emptying of residue, the maintenance of systems, and/or the replacement of filters are done in an enclosed restricted area that shall prevent the contamination of the outside work area. This enclosure area shall be constructed in accordance with the requirements for the main enclosure and will be

inspected and cleared by the Government representative prior to its removal as indicated in paragraph 3.10.

- B. Do not conduct paint removal if wind speeds at the job site are greater than 20-miles per hour unless paint removal is being accomplished by chemical methods. In addition, work must stop and cleanup of all debris must occur before any precipitation begins.
- C. Do not leave debris on polyethylene or other parts of the work area overnight even if the work is not complete. Clean up all debris and contaminated polyethylene at the end of each shift.

3.4 CLEARANCE PRIOR TO PRIMER APPLICATION

- A. Before primer application, a detailed visual inspection will be conducted by the Government representative for unprepared surfaces and visible dust. Any visible dust will be assumed to be lead contaminated. See paragraph 1.3.D. The work area including enclosure floors, walls, and ceiling shall be cleaned. If visible dust or unprepared surfaces are identified, the work area shall be re-cleaned and the inspection will be repeated. The outer enclosure shall remain intact and HEPA-filtered exhaust shall be maintained until final clearance air and inspection is conducted before enclosure removal as indicated in paragraph 3.10. Any personnel entering the work area are required to wear protective coveralls, head cover, gloves, and other necessary equipment including respirator until final clearance sampling of 3 µg/m³ is obtained.

3.5 SAFETY

- A. Ensure the safe passage of persons around the area of work. Comply with AEDC Safety Standard A6. Conduct operations to prevent injury to personnel and damage to existing equipment and structures.

3.6 UTILITIES

- A. Do not interrupt existing utilities or commence power outages without written permission from the Government representative. Obtain an approved, AF Form 103, BCE Work Clearance, in accordance with AEDC Safety Standard B1, from the Government representative prior to interrupting utilities. Do not remove lead from active steam, electrical lines, or high-pressure lines. Wait for appropriate utility outages. Provide back flow prevention devices as required to prevent cross-contamination of water supplies.

3.7 COMMUNICATION DEVICES

- A. Do not use any two-way communication devices unless pre-approved by the AEDC Security Forces.

3.8 WORK CLEARANCES

- A. Obtain work clearances as required by AEDC Safety Standard B1. Perform hazard analysis to ensure all possible health hazards (e.g., toxic gases) have been evaluated and properly controlled. Before entering into a work space, make oxygen and Lower Explosive Limit (LEL) measurements using an NIOSH-approved O₂/LEL metering device. While persons are working, designate a stand-by person, who has been trained within the last 12 months in cardiopulmonary resuscitation (CPR) by the American Red Cross or American Heart Association, to remain outside.

3.9 CLEAN-UP AND DISPOSAL

- A. Clean-up: Maintain surfaces of the lead-control area free of accumulations of paint chips and dust. Restrict the spread of dust and debris; keep waste from being distributed over the work area. Do not dry sweep or use compressed air to clean up the area. At the end of each shift and when the paint-removal operation has been completed, clean the area of visible lead paint contamination by vacuuming with a HEPA-filtered vacuum cleaner. Prevent ground contaminants by enclosing the work area as specified in paragraph 3.1.B. Pre-clean the ground or floor of visible paint chips and obvious visible lead contamination prior to enclosure construction to remove visible contamination already present in the work area.
- B. Visual inspections: Visually inspect the work area after pre-cleaning and before placing any polyethylene sheeting. Re-clean and inspect any area where cleaning has not been adequately done before placing polyethylene sheeting. Inspect enclosures for adequacy prior to removing lead. Do not start abatement procedures prior to release by a Government industrial hygienist who will visually inspect the area for cleanliness and enclosure adequacy.
- C. Inspection assistance: The designated lead-abatement supervisor shall assist in the visual inspection of all areas (enclosure areas cleaned, drums, trucks, and equipment used in lead abatement) as requested by the Government representative. This includes any inspection activity required.
- D. Testing of lead-containing paint residue and used abrasive: Where indicated or when directed by the Government representative, test lead-containing paint residue and used abrasive in accordance with 40 CFR 261 and AEDC Safety Standard E18.
- E. Non-hazardous debris disposal: Transport debris, rubbish, demolition waste, and other non-hazardous materials resulting from work from the site to the construction landfill which is located approximately 2 miles west of the intersection of Avenue E and 6th Street. Do not place edibles or garbage in the construction landfill; use existing dumpster boxes. Dispose of all material

contaminated by lead as hazardous waste in compliance with AEDC Safety Standard E18.

F. Hazardous waste disposal:

1. Where hazardous waste (as identified or listed by 40 CFR 261) is generated, follow the procedures given in AEDC Safety Standard E18 for storing and turning in hazardous waste. These procedures include the requirement for completion of Forms GC-565 and GC-1337, which will be furnished by the Government representative. Return the completed forms to the Government representative prior to transporting the drums to the accumulation point.
2. Collect lead-contaminated waste, scrap, debris, bags, containers, equipment, and clothing, which may produce airborne concentrations of lead particles.
3. Store removed paint, lead-contaminated clothing and equipment, and lead-contaminated dust and cleaning debris into U. S. Department of Transportation 49 CFR 178-approved 55-gallon drums which shall be provided by the contractor. Test the contents to determine the hazardous characteristics, and submit the test results to the Government representative as described in subparagraph 1 above. The contractor shall label and move the waste to a designated accumulation point in accordance with 40 CFR 262 and 49 CFR 172. The Government will be responsible for the further transportation and disposal of the waste.
4. Do not place any hazardous waste, as defined in 40 CFR 261, in any AEDC landfill.

3.10 LEAD ABATEMENT COMPLETION

- A. Samples and tests: Do not remove protective barricades or enclosures until concurrence is received in writing from the Government representative. The Government representative will visually inspect the surfaces of both the enclosure and abated substrate for visible dust contamination, and the contractor shall re-clean all areas as required. Also see paragraph 1.3.D. Wipe and/or microvac samples will be collected to determine that the lead surface contamination does not exceed 500 $\mu\text{g}/\text{ft}^2$ of surface. If any wipe and/or microvac samples do not meet this criterion, re-clean the entire work area. If re-cleaning is required, monitor airborne lead concentrations during and after re-cleaning. Once the visual inspection has been made and wipe and/or microvac samples indicate clean surface levels, clearance air monitoring will be accomplished. If airborne lead concentrations exceed 3 $\mu\text{g}/\text{m}^3$, re-clean the area. Clearance monitoring will be repeated by the Government representative as necessary. HEPA-filtered air systems shall be operated continually until adequate clearance levels are met. In addition to air and wipe samples, soil, gravel, and water samples will be taken in the work area to determine that lead contamination in the area is no greater than 3.7 parts per million above pre-construction levels in soil and gravel or 100 parts per billion in water regardless of the pre-construction levels. Sample results below these limits are required before enclosures or barricades are

removed. Shower water shall be sampled prior to disposal to ensure that the 100-parts-per-billion level is met. See paragraph 3.1.B.4. Analysis of air and wipe samples collected and tested by the Government representative may take 1-1/2 to 3 work days, with bulk and water analysis taking up to 5 work days. Keep the area sealed, barriers intact, and HEPA-filtered air exhaust ventilation in operation until the results of final air samples are received.

- B. Work area inspection: The Government representative will visually inspect the general work area following enclosure removal to ensure the work area has been adequately cleaned and to ensure that no damage has been done to buildings, structures, or equipment.

END OF SECTION

PART 1 GENERAL**1.1 SUMMARY**

- A. Section includes pipe and pipe fittings for: chilled water, refrigerant, and equipment drain piping.

1.2 REFERENCES

- A. American Society of Mechanical Engineers (ASME) Standards:
 - 1. B16.3-98 Malleable Iron Threaded Fittings Class 150 and 300
 - 2. B16.18-84 Cast Copper Alloy Solder Joint Pressure Fittings.
 - 3. B16.22-95 Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
 - 4. B31.9-96 Building Services Piping.
- B. American Society of Mechanical Engineers Boiler and Pressure Vessel Codes (ASME B&PVC) Standard:
 - 1. SEC IX-98 Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators.
- C. American Society for Testing and Materials (ASTM) Standards:
 - 1. A53-99 Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - 2. A234-00 Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
 - 3. B32-00 Solder Metal.
 - 4. B88-99 Seamless Copper Water Tube.
 - 5. B280-99 Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
- D. American Welding Society (AWS) Standards:
 - 1. A5.8-92 Filler Metals for Brazing and Braze Welding.

1.3 SYSTEM DESCRIPTION

- A. Where more than one piping system material is specified, ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are provided.
- B. Use unions, flanges, and couplings downstream of valves and at equipment or apparatus connections. Use non-conducting dielectric connections whenever

jointing dissimilar metals in open systems. Do not use direct welded or threaded connections to valves, equipment or other apparatus.

1.4 SUBMITTALS

- A. Welders' certificate: Include welders' certification of compliance with ASME B&PVC SEC IX. Perform no welding before receipt of contracting officer approval of welder certifications and weld procedure qualifications.

1.5 QUALITY ASSURANCE

- A. Perform work in accordance with ASME B31.9 code for installation of piping systems and ASME B&PVC SEC IX for welding materials and procedures.
- B. Maintain one copy of each document on site.
- C. Valves: Manufacturer's name and pressure rating marked on valve body.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- B. Protect piping from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.7 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

PART 2 PRODUCTS

2.1 CHILLED WATER PIPING

- A. Steel pipe: ASTM A53, Schedule 40 black.
 - 1. Fittings: ASME B16.3, malleable iron or ASTM A234, forged steel welding type.
 - 2. Joints: Threaded or ASME B&PVC SEC IX.
- B. Copper tubing: ASTM B88, Type L, hard drawn.
- C. Fittings: ASME B16.18, cast brass, or ASME B16.22, solder wrought copper.
 - 1. Tee connections: Mechanically extracted collars with notched and dimpled branch tube.
 - 2. Joints: Solder, lead free, ASTM B32, 95-5 tin-antimony, or tin and silver, with melting range 430 to 535°F (220 to 280°C). Braze, AWS A5.8 BCuP

silver/phosphorus/copper alloy with melting range 1190 to 1480°F (640 to 805°C).

2.4 EQUIPMENT DRAINS AND OVERFLOWS

- A. Steel pipe: ASTM A53, Schedule 40 galvanized. Grade B.
 - 1. Fittings: Galvanized cast iron, or ASME B16.3 malleable iron.
 - 2. Joints: Threaded, or grooved mechanical couplings.
- B. Copper tubing: ASTM B88, Type M or L, hard drawn.
 - 1. Fittings: ASME B16.18, cast brass, or ASME B16.22 solder wrought copper.
 - 2. Joints: Solder, lead free, ASTM B32, 95-5 tin-antimony, or tin and silver, with melting range 430 to 535°F (220 to 280°C).

2.5 REFRIGERANT PIPING

- A. Copper Tubing: ASTM B280, Type ACR hard drawn.
 - 1. Fittings: ASME B16.22 wrought copper.
 - 2. Joints: Braze, AWS A5.8 BCUP silver/phosphorus/copper alloy with 15% silver with melting range between 1190 to 1480°F.

2.6 UNIONS, FLANGES, AND COUPLINGS

- A. Unions for pipe 2 inches and under:
 - 1. Ferrous piping: 150 psig malleable iron, threaded.
 - 2. Copper pipe: Bronze, soldered joints.
- B. Flanges for pipe over 2 inches:
 - 1. Ferrous piping: 150 psig forged steel, slip-on.
 - 2. Copper piping: Bronze.
 - 3. Gaskets: 1/16-inch thick preformed neoprene.
- C. Dielectric connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.7 FLEXIBLE CONNECTORS

- A. Manufacturers:
 - 1. Metraflex Co.
 - 2. Flex-weld Inc.
 - 3. Anamet Industries.
 - 4. Approved equal.

- B. Corrugated bronze hose with single layer of stainless steel exterior braiding, minimum 9 inches long with copper tube ends; for maximum working pressure of 500 psig.

2.8 GATE VALVES

- A. Up to and including 2 inches: Bronze body, bronze trim, rising stem, hand-wheel, inside screw, single wedge or disc, solder ends.
- B. Over 2 inches and larger: Class 125 iron body, bronze trim, outside screw and yoke, hand-wheel, solid wedge disc, flanged ends.
- C. Hose bibb: Brass, 3/4-inch threaded end.

2.9 BALL VALVES

- A. Up to and including 2 inches: Bronze one-piece body, stainless steel ball, Teflon seats and stuffing box ring, lever handle, solder ends.

2.10 CHECK VALVES

- A. Iron body, bronze trim, flanged connections, EPDM soft seat, chatter-preventing spring, and calibrated adjustment permitting flow regulation.

PART 3 EXECUTION

3.1 PREPARATION

- A. Ream pipe and tube ends. Remove burrs.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

3.2 INSTALLATION

- A. Install chilled water piping in accordance with ASME B31.9.
- B. Install piping to conserve building space, and not interfere with use of space.
- C. Group piping whenever practical at common elevations.

- D. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- E. Provide clearance for insulation and access to valves and fittings.
- F. Insulate piping and equipment.
- G. Provide 3/4-inch hose bibbs at low points of piping and where shown on the drawings.

3.3 FIELD QUALITY CONTROL

- A. Piping tests: Conduct piping tests before joints are covered and after thrust blocks have sufficiently hardened. Fill pipeline 24 hours prior to testing and apply test pressure to stabilize system. Use only potable water.
- B. Hydrostatic tests: Test at not less than 1-1/2 times working pressure for two hours. Increase pressure in 50-psi increments and inspect each joint between increments. Hold at test pressure for one hour, decrease to 0 psi. Slowly increase again to test pressure and hold for one more hour. Remake leaking joints with new materials and repeat test.

END OF SECTION

PART 1 GENERAL**1.1 SECTION INCLUDES**

- A. Pressure gauges.
- B. Pressure gauge taps.
- C. Thermometers and thermometer wells.
- D. Air vents.
- E. Strainers.
- F. Balancing valves.

1.2 REFERENCES

- A. American Society of Mechanical Engineers (ASME) Standard:
 - 1. B40.1-98 Pressure Gauges and Gauge Attachments
- B. American Society for Testing and Materials (ASTM) Standards:
 - 1. E1-98 ASTM Thermometers.
 - 2. E77-98 Inspection and Verification of Thermometers.
- C. Underwriters Laboratories, Inc. (UL) Standard:
 - 1. 393-96 Safety Indicating Pressure Gauges for Fire-Protection Service.

1.3 ENVIRONMENTAL REQUIREMENTS

- A. Do not install instruments when areas are under construction, except for required rough in, taps, supports, and test plugs.

1.4 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

PART 2 PRODUCTS

2.1 PRESSURE GAUGES

- A. Manufacturers:
 - 1. Weiss Instrument.
 - 2. Trerice Company.
 - 3. Three D Instruments.
 - 4. Approved equal.
- B. Gauge: ASME B40.1, UL 393 with bourdon tube, rotary brass movement, brass socket, front calibration adjustment, black scale on white background.
 - 1. Case: Steel or cast aluminum.
 - 2. Bourdon tube: Brass.
 - 3. Dial size: 2 inch, minimum.
 - 4. Mid-scale accuracy: Two percent.
 - 5. Scale: psi.
 - 6. Range: 0-100 psi.

2.2 PRESSURE GAUGE TAPS

- A. Manufacturers:
 - 1. Trerice Company.
 - 2. Three D Instrument.
 - 3. Stockham.
 - 4. Approved equal.
- B. Needle valve:
 - 1. Brass, 1/4-inch NPT for minimum 300 psi.
- C. Ball valve:
 - 1. Brass, 1/4-inch NPT for 250 psi.
- D. Pulsation damper:
 - 1. Pressure snubber, brass with 1/4-inch NPT connections.
- E. Siphon:
 - 1. Steel, Schedule 40, 1/4-inch NPT angle, or straight pattern.

2.3 STEM TYPE THERMOMETERS

- A. Manufacturers:
 - 1. Trerice Company.
 - 2. Weiss Instruments.
 - 3. Siebe/Foxboro Company.
 - 4. Approved equal.

- B. Thermometer: ASTM E1, red appearing liquid, lens front tube, cast aluminum case with enamel finish shall be designed for outdoor installation.
 - 1. Size: 9-inch scale.
 - 2. Window: Clear glass.
 - 3. Stem: Brass, 3/4-inch NPT, 3 1/2-inch long.
 - 4. Accuracy: ASTM E77 two percent.
 - 5. Calibration: Degrees F.

2.4 THERMOMETER SUPPORTS

- A. Socket: Brass separable sockets for thermometer stems with or without extensions as required, and with cap and chain.

2.5 TEST PLUGS

- A. Manufacturers:
 - 1. Tetric Company.
 - 2. Keystone.
 - 3. MG Piping Products.
 - 4. Approved equal.
- B. One-fourth inch NPT brass fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with:
 - 1. Neoprene core for temperatures up to 200°F.
 - 2. Norel core for temperatures up to 350°F.
 - 3. Viton core for temperatures up to 400°F.

2.6 AIR VENTS

- A. Manufacturers:
 - 1. Bell and Gossett.
 - 2. Armstrong.
 - 3. Taco.
 - 4. Approved equal.
- B. Manual type: Short vertical sections of 2-inch diameter pipe to form air chamber, with 1/8-inch brass needle valve at top of chamber.
- C. Float type: Brass or semi-steel body, copper, polypropylene, or solid non-metallic float, stainless steel valve and valve seat; suitable for system operating temperature and pressure; with isolating valve.
- D. Washer type: Brass with hydroscopic fiber discs, vent ports, adjustable cap for manual shut-off, and integral spring loaded ball check valve.

2.7 STRAINERS

- A. Manufacturers:
 - 1. Zurn.
 - 2. Armstrong.
 - 3. Stockham.
 - 4. Spirax/Sarco.
 - 5. Approved equal.
- B. Size 2 inches and under:
 - 1. Screwed brass or iron body for 150 psig working pressure, Y pattern with 1/32 inch stainless steel perforated screen.
- C. Size 2 1/2 to 6 inches:
 - 1. Flanged bronze or iron body for 150 psig working pressure, Y pattern with 1/8-inch stainless steel perforated screen.

2.8 BALANCING/CALIBRATION VALVES

- A. Manufacturers:
 - 1. Bell and Gossett.
 - 2. Approved equal.
- B. Calibrated balancing valve for proportional system balance positive shut-off, memory stop indicator, equipped with brass readout valves fitted with an integral NPT inserts, drain connection, calibrated nameplate, internal seals, and preformed insulation, rated for 125 psig.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install pressure gauges for each pump, and each chiller with taps before strainers and on suction and discharge of pump; pipe to gauge.
- B. Install gauge taps in piping or on designated ports in pump housing.
- C. Install pressure gauges with pulsation dampers. Provide needle valve or ball valve to isolate each gauge. Install siphon on gauges in steam systems. Extend nipples and siphons to allow clearance from insulation.
- D. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2 1/2 inches for installation of thermometer sockets. Ensure sockets allow clearance from insulation.

- E. Install thermometer sockets at chilled water supply and return connection at chiller.
- F. Coil and conceal excess capillary on remote element instruments.
- G. Install gauges and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.
- H. Adjust gauges and thermometers to final angle, clean windows and lenses, and calibrate to zero.
- I. Locate test plugs, adjacent thermometers, and thermometer sockets adjacent to pressure gauges and pressure gauge taps.
- J. Provide drain and hose connections with valve on strainer blow down connection.
- K. Provide air vents on chilled water supply and return piping at highest points of chiller connection piping.

3.2 CLEANING

- A. Clean and flush glycol system before glycol solution is added by the Government.

3.3 PROTECTION OF INSTALLED CONSTRUCTION

- A. Do not install pressure gauges until after systems are pressure treated.

END OF SECTION

SECTION 15140
SUPPORTS AND ANCHORS

PART 1 GENERAL**1.1 SECTION INCLUDES**

- A. Pipe hangers, supports and associated anchors.
- B. Sleeves and seals.
- D. Flashing and sealing pipes and pipe stacks.

1.2 REFERENCES

- A. American Society of Mechanical Engineers (ASME) Standard:
 - 1. B31.9-96 Building Services Piping.
- B. Sheet Metal and Air-Conditioning Contractors' National Association, Inc. (SMACNA) Standard:
 - 1. HVAC Duct Construction Standards - Metal and Flexible, 1995.

1.4 SUBMITTALS

- A. Product data, including load capacity.

PART 2 PRODUCTS**2.1 PIPE HANGERS AND SUPPORTS**

- A. Conform to ASME B31.9.
- B. Hangers for pipe sizes 1/2 to 1-1/2 inch carbon steel: Pipe or conduit hanger.
- C. Hangers for cold pipe sizes 2 inch and larger: Carbon steel, adjustable, medium clevis hanger.
- D. Hangers for hot pipe sizes 2 to 4 inches: Carbon steel, adjustable, medium clevis hanger.
- E. Hangers for hot pipe sizes 6 inches and over: Adjustable steel yoke, cast iron roll, double hanger.
- F. Multiple or trapeze hangers: Steel channels with welded spacers and hanger rods.

- G. Multiple or trapeze hangers for hot pipe 6 inches and over: Steel channels with welded spacers and hanger rods, cast iron roll.
- H. Wall support for pipe sizes to 3 inches: Cast iron hooks.
- I. Wall support for pipe sizes 4 inches and over: Welded steel bracket and wrought steel clamp.
- J. Wall support for hot pipe sizes 6 inches and over. Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.
- K. Vertical support: Steel riser clamp.
- L. Floor support for cold pipe and hot pipe up to 6 inches: Cast iron pipe saddle, floor flange, and concrete pier or steel support.
- M. Floor support for hot pipe sizes 6 inches and over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
- N. Copper pipe support. Carbon steel rings, adjustable, copper plated.
- O. Shield for insulated piping 2 inches and larger: 16-gauge galvanized steel shield over insulation in 180 degree segments, minimum 12 inches long at pipe support.

2.2 DUCT HANGERS AND SUPPORTS

- A. Duct hangers: Galvanized steel band or rolled angle iron and 3/8-inch steel rods, in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- B. Wall supports: Galvanized steel band or fabricated angle bracket, provided in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

2.3 HANGER RODS

- A. Steel hanger rods: Threaded both ends, or continuous threaded.

2.4 SLEEVES

- A. Sleeves for pipes through fire rated and fire resistive floors and walls, and fireproofing: Prefabricated fire rated sleeves including seals, UL listed.
- B. Fire stopping insulation: Glass fiber type, non-combustible.

- C. Caulk: Firestop type, F-rating 3 hours, T-rating 0 hours.

2.5 FABRICATION

- A. Provide hangers such that there is no disengagement of supported pipe.
- B. Size sleeves large enough to allow for movement due to expansion and contraction. Provide the continuous insulation wrapping.

PART 3 EXECUTION

3.1 PIPE HANGERS AND SUPPORTS

- A. Support horizontal piping as follows:

PIPE SIZE	MAXIMUM HANGER SPACING	HANGER DIAMETER
1/2 to 1-1/4 inches	6'-6"	3/8"
1 1/2 to 2 inches	10'	3/8"
2-1/2 to 3 inches	12'	1/2"
4 inches	14'	5/8"
6 inches	17'	5/8"
8 inches	19'	7/8"

- B. Install hangers to provide minimum 1/2-inch space between finished covering and adjacent work.
- C. Use hangers with 1-1/2 inch minimum vertical adjustment.
- D. Where one or more pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- E. Support piping at elbows and valves.

3.2 SLEEVES

- A. Where piping penetrates wall or floor, close off space between pipe and adjacent work with fire stopping insulation and caulk seal airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

END OF SECTION

SECTION 15190
MECHANICAL IDENTIFICATION

PART 1 GENERAL**1.1 SECTION INCLUDES**

- A. Nameplates.
- B. Tags.
- C. Stencils.
- D. Pipe Markers.

PART 2 PRODUCTS**2.1 NAMEPLATES**

- A. Description: Laminated three-layer plastic with engraved black letters on light contrasting background color.

PART 3 EXECUTION**3.1 PREPARATION**

- A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION

- A. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- B. Identify air handling units, condensing units, pumps, chillers, heat transfer equipment, tanks, and water treatment devices with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.
- C. Identify control panels and major control components outside panels with plastic nameplates.
- D. Provide ceiling tacks to locate valves or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION

PART 1 GENERAL**1.1 SECTION INCLUDES**

- A. Inertia bases.
- B. Vibration isolation.

1.2 PERFORMANCE REQUIREMENTS

- A. Provide vibration isolation on motor driven equipment over 0.5 HP, plus connected piping and ductwork.
- B. Provide minimum static deflection of isolators for equipment as indicated.
 - 1. Basement, Under 20 hp:
 - a. Over 1500 rpm: 0.1 inch
 - 2. Basement, Over 20 hp:
 - a. Over 1500 rpm: 0.15 inch
 - 3. Upper Floors, Critical:
 - a. Over 1500 rpm: 0.5 inch
- C. Upper floor locations shall be considered critical unless otherwise indicated.

PART 2 PRODUCTS**2.1 INERTIA BASES**

- A. Structural Bases:
 - 1. Design: Sufficiently rigid to prevent misalignment or undue stress on machine, and to transmit design loads to isolators and snubbers.
 - 2. Construction: Welded structural steel with gusseted brackets, supporting equipment and motor with motor slide rails.

2.2 VIBRATION ISOLATORS

- A. Open Spring Isolators:
 - 1. Spring Isolators:
 - a. For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.
 - b. Code: Color code springs for load carrying capacity.
 - 2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.

3. Spring Mounts: Provide with leveling devices, minimum 0.25 inch thick neoprene sound pads, and zinc chromate plated hardware.
 4. Sound Pads: Size for minimum deflection of 0.05 inch; meet requirements for neoprene pad isolators.
- B. Restrained Spring Isolators:
1. Spring Isolators:
 - a. For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.
 - b. Code: Color code springs for load carrying capacity.
 2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
 3. Spring Mounts: Provide with leveling devices, minimum 0.25 inch thick neoprene sound pads, and zinc chromate plated hardware.
 4. Sound Pads: Size for minimum deflection of 0.05 inch; meet requirements for neoprene pad isolators.
 5. Restraint: Provide heavy mounting frame and limit stops.
- C. Closed Spring Isolators:
1. Spring Isolators:
 - a. For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.
 - b. Code: Color code springs for load carrying capacity.
 2. Type: Closed spring mount with top and bottom housing separated with neoprene rubber stabilizers.
 3. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
 4. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators, and neoprene side stabilizers with minimum 0.25 inch (7 mm) clearance.
- D. Restrained Closed Spring Isolators:
1. Spring Isolators:
 - a. For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.
 - b. Code: Color code springs for load carrying capacity.
 2. Type: Closed spring mount with top and bottom housing separated with neoprene rubber stabilizers.
 3. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
 4. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators, and neoprene side stabilizers with minimum 0.25 inch clearance and limit stops.

- E. Spring Hanger:
 - 1. Spring Isolators:
 - a. For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.
 - b. Code: Color code springs for load carrying capacity.
 - 2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
 - 3. Housings: Incorporate rubber hanger with threaded insert.
 - 4. Misalignment: Capable of 20 degree hanger rod misalignment.
- F. Neoprene Pad Isolators:
 - 1. Rubber or neoprene waffle pads.
 - a. 30 durometer.
 - b. Minimum 1/2 inch thick.
 - c. Maximum loading 40 psi.
 - d. Height of ribs shall not exceed 0.7 times width.
 - 2. Configuration: Single layer. 1/2 inch thick waffle pads bonded each side of 1/4 inch thick steel plate.
- G. Rubber Mount or Hanger: Molded rubber designed for 0.5 inch deflection with threaded insert.
- H. Glass Fiber Pads: Neoprene jacketed pre-compressed molded glass fiber.
- I. Seismic Snubbers:
 - 1. Type: Non-directional and double acting unit consisting of interlocking steel members restrained by neoprene elements.
 - 2. Neoprene Elements: Replaceable, minimum of 0.75 inch thick.
 - 3. Capacity: 4 times load assigned to mount groupings at 0.4 inch deflection.
 - 4. Attachment Points and Fasteners: Capable of withstanding 3 times rated load capacity of seismic snubber.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install isolation for motor driven equipment.
- C. Bases:
 - 1. Set steel bases for one inch (25 mm) clearance between housekeeping pad and base.
 - 2. Set concrete inertia bases for 2 inch (50 mm) clearance between housekeeping pad and base.
 - 3. Adjust equipment level.

- D. Install spring hangers without binding.
- E. On closed spring isolators, adjust so side stabilizers are clear under normal operating conditions.
- F. Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height. When full load is applied, adjust isolators to load to allow shim removal.
- G. Provide pairs of horizontal limit springs on fans with more than 6.0 inch static pressure, and on hanger supported, horizontally mounted axial fans.
- H. Provide resiliently mounted equipment, piping, and ductwork with seismic snubbers. Each inertia base shall have minimum of four seismic snubbers located close to isolators. Snub equipment designated for post disaster use to 0.05 inch maximum clearance. Other snubbers shall have clearance between 0.15 inch and 0.25 inch.
- I. Support piping connections to isolated equipment resiliently to nearest flexible pipe connector as follows:
 - 1. Up to 4 Inch Diameter: First three points of support.
 - 2. 5 to 8 Inch Diameter: First four points of support.
 - 3. 10 inch Diameter and Over: First six points of support.
 - 4. Select three hangers closest to vibration source for minimum 1.0 inch static deflection or static deflection of isolated equipment. Select remaining isolators for minimum 1.0 inch static deflection or 1/2 static deflection of isolated equipment.
- J. Connect wiring to isolated equipment with flexible hanging loop.

3.2 PIPE ISOLATION SCHEDULE

Pipe Size (Inches)	Isolated Distance from Equipment
1	120 diameters
2	90 diameters
3	80 diameters
4	75 diameters
6	60 diameters
8	60 diameters
10	54 diameters

END OF SECTION

PART 1 GENERAL**1.1 SECTION INCLUDES**

- A. Piping insulation.
- B. Jackets and accessories.

1.2 CODES AND STANDARDS

- A. American Society for Testing and Materials (ASTM) Standards:
 - 1. B209-00 Aluminum and Aluminum-Alloy Sheet and Plate.
 - 2. C177-97 Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
 - 3. C335-95 Steady-State Heat Transfer Properties of Horizontal Pipe Insulation.
 - 4. C534-00 Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
 - 5. C921-89 Properties of Jacketing Materials for Thermal Insulation.
 - 6. D1056-00 Flexible Cellular Materials-Sponge or Expanded Rubber.
 - 7. E84-01 Surface Burning Characteristics of Building Materials.
 - 8. E96-00 Water Vapor Transmission of Materials.
- C. Underwriters Laboratories, Inc. (UL) Standard:
 - 1. 723-96 Surface Burning Characteristics of Building Materials.

1.3 SUBMITTALS

- A. Product data to include product description, list of materials and thickness for each service and location.

1.4 QUALITY ASSURANCE

- A. Materials: Flame spread/smoke developed rating of 25/50 respectively or less in accordance with ASTM E84 and UL 723.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and protect products at site.
- B. Deliver materials to site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

- C. Store insulation in original wrapping and protect from weather and construction traffic.
- D. Protect insulation against dirt, water, chemical, and mechanical damage.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 PRODUCTS

2.1 GLASS FIBER

- A. Insulation: Rigid molded, noncombustible.
 - 1. 'K' ('ksi') value : ASTM C335, 0.24 at 75 degrees mean temperature.
 - 2. Minimum Service Temperature: -20° F.
 - 3. Maximum Service Temperature: 500° F.
 - 4. Maximum Moisture Absorption: 0.2 percent by volume.
- B. Vapor barrier jacket.
 - 1. ASTM C921, White kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
 - 2. Moisture vapor transmission: ASTM E96; 0.02 perm inches.
 - 3. Secure with self sealing longitudinal laps and butt strips.
 - 4. Secure with outward clinch expanding staples and vapor barrier mastic.
- C. Tie wire: 18 gauge stainless steel with twisted ends on maximum 12-inch centers.

2.2 CELLULAR FOAM

- A. Manufacturer:
 - 1. Armstrong. Model: Armaflex FR II.
 - 2. Approved equal.
- B. Insulation: ASTM C534; flexible, cellular elastomeric, molded, with factory applied coating.
 - 1. 'K' value: ASTM C177; 0.27 at 75° F.
 - 2. Minimum service temperature: -40° F.
 - 3. Maximum service temperature: 220° F.
 - 4. Maximum moisture absorption: ASTM D1056; 6.0 percent by volume.

5. Moisture vapor transmission: ASTM E96; 0.20 perm-inches.
 6. Connection: Waterproof vapor barrier adhesive.
- C. Elastomeric foam adhesive:
1. Air dried, contact adhesive, compatible with insulation.
- D. Provide 0.20-inch-thick aluminum.
- E. Aluminum jacket.
1. ASTM B209, 0.016-inch thick sheet.
 2. Finish: Smooth.
 3. Joining: Longitudinal slip joints and 2-inch laps.
 4. Fittings: 0.016-inch thick die shaped fitting covers with factory attached protective liner.
 5. Metal jacket bands: 3/8-inch wide, 0.015-inch thick aluminum.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that piping has been tested before applying insulation materials.
- B. Verify that surfaces are clean, foreign material removed, and dry.

3.2 INSTALLATION

- A. Install materials in accordance with manufacturer's instructions.
- B. On exposed piping, locate insulation and cover seams in least visible locations.
- C. For insulated pipes:
1. Provide all weather jackets, with vapor barrier, factory applied.
 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe.
 3. Finish with glass cloth and adhesive.
 4. PVC fitting covers may be used.
- D. Inserts and shields:
1. Application: Piping 2 inches diameter or larger.
 2. Shields: Galvanized steel between pipe hangers and pipe insulation.
 3. Shield configuration: Minimum 12 inches long, of same contour as adjoining insulation; may be factory fabricated.
- E. On exposed piping, locate insulation and cover seams in least visible locations.

F. Finish insulation at supports, protrusions, and interruptions.

G. Provide aluminum jacket on all insulated piping outside of building.

3.3 INSULATION SCHEDULE

PIPING SYSTEMS	INSULATION THICKNESS
Indoor Chilled Water Piping	1 inch Glass Fiber
Outdoor Chilled Water	1-inch Cellular Foam
Refrigeration	1-inch Cellular Foam

END OF SECTION

SECTION 15290
DUCTWORK INSULATION

PART 1 GENERAL**1.1 SECTION INCLUDES**

- A. Ductwork insulation.

1.2 REFERENCES

- A. American Society for Testing and Materials (ASTM) Standards:
 - 1. C518-91 Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
 - 2. C553-92 Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
 - 3. E84-01 Surface Burning Characteristics of Building Materials.
 - 4. E96-00 Water Vapor Transmission of Materials.
- B. Sheet Metal and Air Conditioning Contractors' National Association, Inc. (SMACNA) Standard:
 - 1. HVAC Duct Construction Standards - Metal and Flexible, 1995.
- C. Underwriters Laboratories, Inc (UL) Standard:
 - 1. 723-96 Surface Burning Characteristic of Building Materials.

1.3 SUBMITTALS

- A. Product Data: Provide product description, list of materials and thickness for each service, and locations.
- B. Manufacturer's Installation Instructions: Indicate procedures which ensure acceptable workmanship and installation standards will be achieved.

1.4 REGULATORY REQUIREMENTS

- A. Materials: Flame spread/smoke developed rating of 25/50 in accordance with ASTM E84.

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

- B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 PRODUCTS

2.1 GLASS FIBER, FLEXIBLE

- A. Manufacturers:
 - 1. Manville.
 - 2. Knauf.
 - 3. Certain Teed.
 - 4. Approved equal.
- B. Insulation: ASTM C553; flexible, noncombustible blanket.
 - 1. 'K' value: ASTM C518, 0.31 at 75 degrees F.
 - 2. Maximum service temperature: 250 degrees F.
 - 3. Maximum moisture absorption: 0.50 percent by volume.
 - 4. Density: 0.75 lb/cu ft.
- C. Vapor Barrier Jacket:
 - 1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
 - 2. Moisture vapor transmission: ASTM E96; 0.04 perm.
 - 3. Secure with pressure sensitive tape.
- D. Vapor Barrier Tape:
 - 1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.
- E. Fire characteristics:
 - 1. Flame spread: ASTM E84 or UL 723.
 - 2. Smoke development: ASTM E84 or UL 723.
- F. Tie Wire: Annealed steel, 16 gage.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that ductwork has been tested before applying insulation materials.
- B. Verify that surfaces are clean, foreign material removed, and dry.

3.2 INSTALLATION

- A. Install in accordance with SMACNA HVAC Duct Construction Standards-Metal and Flexible.

B. External duct insulation application:

1. Secure insulation with staples, tape, or wires.
2. Install without sag or underside of ductwork. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift ductwork off trapeze hangers and insert spacers.

3.3 DUCTWORK INSULATION SCHEDULE

<u>DUCTWORK</u>	<u>THICKNESS</u>
All Supply and Return Interior Ductwork	1 1/2-inch, kraft backed glass fiber

END OF SECTION

PART 1 GENERAL**1.1 SECTION INCLUDES**

- A. Base mounted pumps.
- B. Vertical in-line pumps.

1.2 PERFORMANCE REQUIREMENTS

- A. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

1.3 SUBMITTALS

- A. Product Data: Provide certified pump curves showing performance characteristics with pump and system operating point plotted. Include net positive suction head (NPSH) curve. Include electrical characteristics and connection requirements.

PART 2 PRODUCTS**2.1 BASE MOUNTED PUMPS**

- A. Type: Horizontal shaft, single stage, direct connected, for 125 psig working pressure, and capable of being serviced without disturbing piping connections.
- B. Casing: Cast iron, with suction and discharge gage ports, renewable bronze casing wearing rings, seal flush connection, drain plug, flanged suction and discharge.
- C. Impeller: Bronze, fully enclosed, keyed to shaft.
- D. Bearings: Grease lubricated roller or ball bearings.
- E. Shaft: Alloy steel with copper, bronze, or stainless steel shaft sleeve.
- F. Seal: Carbon rotating against a stationary ceramic seat, 225 degrees F maximum continuous operating temperature.
- G. Drive: Flexible coupling with coupling guard.

H. Baseplate: Cast iron or fabricated steel with integral drain rim.

I. Performance: Refer to schedule on drawings.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions, within drip pan.
- B. Provide access space around pumps for service. Provide no less than minimum as recommended by manufacturer.
- C. Decrease from line size with long radius reducing elbows or reducers, or a suction diffuser. Support piping adjacent to pump such that no weight is carried on pump casings. For base mounted pumps, provide supports under elbows on pump suction and discharge line sizes 4 inches and over.
- D. Provide line sized shut-off valve and strainer on pump suction, and line sized soft seat check valve and balancing valve on pump discharge.
- E. Provide air cock and drain connection on horizontal pump casings.
- F. Check, align, and certify alignment of base mounted pumps prior to start-up.
- G. Install base mounted pumps with anchor bolts within drip pan and on vibration isolation, set and level.
- H. Insulate pump, connecting piping, and piping specialties with 1-inch thick glass fiber and respective vapor barrier jacket where products are in accordance with Section 15260, Piping Insulation.

END OF SECTION

SECTION 15621
ROTARY SCREW WATER CHILLER

PART 1 GENERAL**1.1 SECTION INCLUDES**

- A. Chiller package.
- B. Charge of refrigerant and oil.
- C. Controls and control connections.
- D. Chilled water connections.
- E. Condenser water connections.
- F. Auxiliary water connections.
- G. Starters.
- H. Electrical power connections.

1.2 REFERENCES

- A. Air-Conditioning and Refrigeration Institute (ARI) Standard:
 - 1. 550 Water Chilling Packages Using the Vapor Compression Cycle, 1998.
- B. American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) Standards:
 - 1. 15-94 Safety Code for Mechanical Refrigeration.
 - 2. 90A-80 Energy Conservation in New Building Design.
- C. American Society of Mechanical Engineers (ASME) Standard:
 - 1. B31.9-96 Building Services Piping.
- D. American Society of Mechanical Engineers Boiler & Pressure Vessel Code (ASME B&PVC) Standard:
 - 1. SEC II-C-98 Welding Rods, Electrodes, and Filler Metals.
 - 2. SEC VIII-98 Rules For Construction of Pressure Vessels Non-Interfiled.
- E. Underwriters Laboratories, Inc. (UL) Standard:
 - 1. 465-82 Safety Central Cooling Air Conditioners.

1.3 SUBMITTALS

- A. Shop drawings: Indicate components, assembly, dimensions, weights and loadings, required clearances, and location and size of field connections. Indicate equipment, piping and connections, valves, strainers, and thermostatic valves required for complete system.
- B. Product Data: Indicate rated capacities, sound data, weights, specialties and accessories, electrical requirements and wiring diagrams.
- C. Written Certification: Clarify that components of package not furnished by manufacturer have been selected in accordance with manufacturer's requirements.
- D. Manufacturer's Installation Instructions.
- E. Performance Data: Indicate energy input versus cooling load output from 0 to 100 percent of full load at specified and minimum condenser water temperature.

1.4 OPERATION AND MAINTENANCE DATA

- A. Submit manufacturer's standard operation data.
- B. Include start-up instructions, maintenance data, parts lists, controls, and accessories. Include trouble-shooting guide.
- C. Submit manufacturer's standard maintenance data.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in the manufacture of the products specified in this Section with minimum ten years experience.

1.6 REGULATORY REQUIREMENTS

- A. Conform to ARI 550 code for testing and rating of centrifugal and rotary chillers.
- B. Conform to UL 465 code for construction of centrifugal chillers and rotary chillers.
- C. Conform to ASME B&PVC SEC VIII for construction and testing of centrifugal and rotary chillers.
- D. Conform to ASHRAE 15 code for construction and operation of chillers.

- E. Provide certification of inspection for conforming authority having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
- B. Protect units from physical damage. Leave factory-shipping covers in place until installation.

1.8 WARRANTY

- A. Provide one-year parts and labor for all components.
- B. Provide second through fifth year parts only warranty for compressors.

PART 2 PRODUCTS

2.1 MANUFACTURED UNITS

- A. Provide factory assembled and tested, packaged, air cooled, liquid chillers consisting of rotary compressors, compressor motor, condenser, evaporator, refrigeration accessories, instrument and control panel including gages and indicating lights, auxiliary components and accessories, and motor starters. Construction and ratings shall be in accordance with ARI 550.
- B. Units shall have Energy Efficiency Rating (EER) not less than prescribed by ASHRAE 90A.
- C. Unit shall come pre-charged with refrigerant R-22 or R134a. No other refrigerants will be accepted.

2.2 COMPRESSORS

- A. Compressor shall be a twin screw type compressor (rotary screw) that is semi-hermetic, direct drive, 3600 RPM with capacity control slide valve, and rolling element bearings.
- B. Differential refrigerant pressure oil pump and oil heater.
- C. Motor shall be a suction gas cooled, hermetically sealed, two-pole squirrel cage induction motor.

2.3 EVAPORATOR

- A. Provide evaporator of shell and tube type, seamless or welded steel construction with cast iron or fabricated steel heads, seamless copper tubes or red brass tubes with integral fins, rolled or silver brazed into tube sheets.
- B. Design, test, and stamp refrigerant side for 300 psig (310 kPa) working pressure and water side for 215 psig (1034 kPa) working pressure, in accordance with ASME B&PVC SEC VIII.
- C. Insulate evaporator and cold surfaces with 0.75 inch (20 mm) minimum thick flexible insulation with maximum K value of 0.26.
- D. Provide direct immersion thermometer for temperature controller and low temperature cutout.
- E. Provide refrigerant chambers with baffles to distribute entering liquid and separate liquid from leaving gas.
- F. Construction and materials shall conform to ANSI B31.9 and ASME SEC VIII.
- G. Provide heat tape with thermostat to protect evaporator from freezing at ambient temperatures down to -20°F.
- H. Evaporator shell to be provided with a vent, a drain and fittings for temperature control sensors.

2.4 CONDENSERS AND FANS

- A. Condenser shall be air-cooled condenser coils having aluminum fins mechanically banded to internally finned seamless copper tubing. Condenser shall have an integral subcooling circuit for refrigerant and oil.
- B. Factors proof and leak test condenser at 506 psig.
- C. Condenser fans shall be direct drive vertical discharge. Condenser fan shall be dynamically balanced.
- D. Condenser fan motors shall operate with three-phase power and shall have permanently lubricated ball bearings and internal thermal overload protection.
- E. The chiller shall operate at 25°F and above ambient temperature.

2.5 REFRIGERANT CIRCUITS

- A. The chiller shall be provided with two separate refrigerant circuits with one compressor per circuit.
- B. Each refrigerant circuit shall include a compressor suction and discharge service valve, liquid line shut off valve, removable core filter drier, liquid line sight glass with moisture indicator, charging port, and an electronic expansion valve.

2.6 CONTROLS

- A. All unit controls shall be housed in a weather tight enclosure.
- B. All controls shall be factory mounted and tested prior to shipment.
- C. All control functions shall be accomplished via microcomputer controls.
- D. Provide the following safety controls arranged so that continued abnormal operating any one will shut down machine and require manual reset:
 - 1. High refrigerant (condenser) temperature.
 - 2. Low refrigerant (evaporator) temperature.
 - 3. Motor winding temperature.
 - 4. Motor overload.
- E. Provide the following unit protective functions so that operating any one will shut down machine and automatically reset:
 - 1. Loss of chilled water flow.
 - 2. Evaporator freezing.
- F. Provide a menu driven or graphical display for monitoring and checking operational data points and diagnostic checks.

2.7 OPTIONS

- A. Removable architectural louvered panels that cover the complete condensing coils and service area beneath condensing coils. Panels shall be designed to match chiller.
- B. Control power transformer integral to chiller that eliminates the need for a separate circuit for controls.
- C. Single point power circuit breaker.
- D. Neoprene isolators.

- E. Disconnect switch.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide for connection to electrical service.
- C. Align chiller on concrete foundations, sole plates, and sub-bases. Level, grout, and bolt in place.
- D. Provide evaporator connections to chilled water piping. On inlet, provide thermometer well for temperature controller, thermometer well and thermometer, nipple and flow switch, flexible pipe connector, pressure gage, and shut-off valve. On outlet, provide thermometer well and thermometer, flexible pipe connector, pressure gage, and combination shut-off/ balancing valve.
- E. Insulate evaporator and cold surfaces.

3.2 MANUFACTURER'S FIELD SERVICES

- A. Provide services of factory trained representative for minimum one day to leak test, refrigerant pressure test, evacuate, dehydrate, charge, start-up, calibrate controls, and instruct Owner on operation and maintenance.
- B. Supply initial charge of refrigerant and oil.

3.3 DEMONSTRATION

- A. Demonstrate system operation and verify specified performance. Refer to Section 15990.

END OF SECTION

PART 1 GENERAL**1.1 SUMMARY**

- A. This section applies to all ductwork for air conditioning, exhaust, and ventilation system as indicated on the drawings and specified herein.

1.2 CODES AND STANDARDS

- A. National Fire Protection Association (NFPA) Standard:
 - 1. 90A-99 Installation of Air Conditioning and Ventilating Systems.
- B. Sheet Metal and Air Conditioning Contractors National Association (SMACNA) Standard:
 - 1. Rectangular Industrial Duct Construction Standard (RIDCS), 1980.
- C. Underwriters Laboratories (UL) Standard:
 - 1. 181-96 Factory-Made Air Ducts and Connectors.

PART 2 PRODUCTS

- 2.1 Ductwork: Galvanized steel, prime lock-forming quality, with a zinc coating of 1.25 ounces per square foot on each side; S-slip and drive construction.
- 2.2 Flexible duct: Flexible fiberglass duct with a highly flexible, vinyl-coated, spring steel helix bonded to a vinyl coated fiberglass mesh, insulating layer of fiberglass blanket, an outer vapor barrier jacket, code compliance with NFPA 90A when tested in accordance with UL 181, Class 1.
- 2.3 Internally Lined ductwork is not acceptable.

PART 3 EXECUTION

- 3.1 Fabricate, install, and support low-pressure ductwork in accordance with SMACNA Rectangular Industrial Duct Construction Standard.
- 3.2 Add supplemental bracing to prevent sagging and drumming.
- 3.3 Cross-break ductwork over 10-inch dimension on either side.
- 3.4 Use drive slips, folded over to seal corners, for narrow sides of ducts that are 18 inches or less.

- 3.5 Make branch connections and tees with a converging radius elbow, radius tapin, or square takeoff with suitable vanes. Space duct joints to preclude cutting for branch takeoffs or outlet collars.
- 3.6 Make the throat radius of unvaned elbows equal to $\frac{3}{4}$ of the width of the duct. Make a full heel radius. Use a 6-inch-throat radius with full radius vanes and full heel radius; use a 3-inch-square throat and square heel with closed-space, double-thickness turning vanes.
- 3.7 Do not exceed a slope of 1-inch-in-7-inches for increase-in-area transformations. The slope for decrease-in-area transformations may be 1-inch-in-4-inches, but 1-inch-in-7-inches is preferable. With the use of approved vanes, the angle of transformation at connections to equipment and coils shall not exceed 30 degrees on the approaching side and 45 degrees on the leaving side.
- 3.8 Install access doors in ducts on each side of each vaned elbow or tee; and at each splitter damper, volume damper, fire damper and heating coil.
- 3.9 Install flexible ducts for diffuser runouts only. Do not allow runouts to exceed 10 feet in length.

END OF SECTION

SECTION 15990
TESTING, ADJUSTING, AND BALANCING

PART 1 GENERAL**1.1 SECTION INCLUDES**

- A. Testing, adjustment, and balancing of air systems.
- B. Testing, adjustment, and balancing of hydronic systems.
- C. Sound measurement of equipment operating conditions.

1.2 REFERENCES

- A. Associated Air Balance Council Standard (AABC):
 - 1. MN1-89 National Standards.
- B. American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) Standards:
 - 1. Systems Handbook: Testing, Adjusting and Balancing.
- C. National Environmental Balancing Bureau (NEBB) Standard:
 - 1. NEBB Specifications--Testing, Adjusting, and Balancing of Environmental Systems, 1991.

1.3 SUBMITTALS

- A. Provide reports in soft cover, letter size, 3-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations. Submit reports on AABC MN1 National Standards for Total System Balance or NEBB forms. Forms shall include the following information:
 - 1. Title Page:
 - a. Company name
 - b. Company address
 - c. Company telephone number
 - d. Project name
 - e. Project location
 - f. Project Architect
 - g. Project Engineer
 - h. Project Contractor
 - i. Project altitude
 - 2. Instrument List:
 - a. Instrument

- b. Manufacturer
- c. Model
- d. Serial number
- e. Range
- f. Calibration date
- 3. Air Moving Equipment:
 - a. Location
 - b. Manufacturer
 - c. Model
 - d. Air flow, specified and actual
 - e. Return air flow, specified and actual
 - f. Outside air flow, specified and actual
 - g. Total static pressure, total external, specified and actual
 - h. Inlet pressure
 - i. Discharge pressure
 - j. Fan RPM
- 4. Electric Motors:
 - a. Manufacturer
 - b. HP/BHP
 - c. Phase, voltage, amperage; nameplate, actual, no load.
 - d. RPM
 - e. Service factor
 - f. Starter size, rating, heater elements
- 5. Air Distribution Test Sheet:
 - a. Air terminal number
 - b. Room number/location
 - c. Terminal type
 - d. Terminal size
 - e. Area factor
 - f. Design velocity
 - g. Design air flow
 - h. Test (final) velocity
 - i. Test (final) air flow
 - j. Percent of design air flow
- 6. Pump Data:
 - a. Identification/number
 - b. Manufacturer
 - c. Size/model
 - d. Impeller
 - e. Service
 - f. Design flow rate, pressure drop, BHP
 - g. Actual flow rate, pressure drop, BHP
 - h. Discharge pressure
 - i. Suction pressure
 - j. Total operating head pressure
 - k. Shut off, discharge and suction pressures

- l. Shut off, total head pressure
 - m. Diagram of pump curve with points indicated for design and actual operational points on the cover.
 - 7. Chillers:
 - a. Identification/number
 - b. Manufacturer
 - c. Capacity
 - d. Model
 - e. Evaporator entering water temperature, design and actual
 - f. Evaporator leaving water temperature, design and actual
 - g. Evaporator pressure drop, design and actual
 - h. Evaporator water flow rate, design and actual
 - i. Condenser entering water temperature, design and actual
 - j. Condenser leaving water temperature, design and actual
 - k. Condenser pressure drop, design and actual
 - l. Condenser water flow rate, design and actual
 - 8. Cooling Coil Data:
 - a. Identification/number
 - b. Location
 - c. Service
 - d. Manufacturer
 - e. Air flow, design and actual
 - f. Entering air DB temperature, design and actual
 - g. Entering air WB temperature, design and actual
 - h. Leaving air DB temperature, design and actual
 - i. Leaving air WB temperature, design and actual
 - j. Water flow, design and actual
 - k. Water pressure drop, design and actual
 - l. Entering water temperature, design and actual
 - m. Leaving water temperature, design and actual
 - n. Air pressure drop, design and actual
 - 9. Sound Level Report:
 - a. Location
 - b. Octave bands - equipment off
 - c. Octave bands - equipment on
- B. Project record documents: Accurately record actual locations of balancing valves and rough setting.
- C. Agency shall be company specializing in the adjusting and balancing of systems specified in this Section.
- 1. Total system balance shall be performed in accordance with ASHRAE - Systems Handbook.

1.4 SEQUENCING AND SCHEDULING

- A. Sequence work to commence after completion of systems and schedule completion of work before final inspection.
- B. Schedule and provide assistance in final adjustment and test of life safety system with the Government representative and AEDC Fire Department Technical Services.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.1 EXAMINATION

- A. Before commencing work, verify that systems are complete and operable. Ensure the following:
 - 1. Equipment is operable and in a safe and normal condition.
 - 2. Temperature control systems are installed complete and operable.
 - 3. Proper thermal overload protection is in place for electrical equipment.
 - 4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
 - 5. Duct systems are clean of debris.
 - 6. Correct fan rotation.
 - 7. Fire and volume dampers are in place and open.
 - 8. Coil fins have been cleaned and combed.
 - 9. Access doors are closed and duct end caps are in place.
 - 10. Air outlets are installed and connected.
 - 11. Duct system leakage has been minimized.
 - 12. Hydronic systems have been flushed, filled, and vented.
 - 13. Correct pump rotation.
 - 14. Proper strainer baskets are clean and in place.
 - 15. Service and balance valves are open.
- B. Report any defects or deficiencies noted during performance of services to the Contracting Officer.
- C. Promptly report abnormal conditions in mechanical systems or conditions which prevent system balance.
- D. If, for design reasons, system cannot be properly balanced, report as soon as observed.
- E. Beginning of work means acceptance of existing conditions.

3.2 PREPARATION

- A. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to the Contracting Officer to facilitate spot checks during testing.
- B. Provide additional balancing devices as required.

3.3 INSTALLATION TOLERANCES

- A. Adjust air handling systems to plus or minus 5 percent for supply systems and plus or minus 10 percent for return and exhaust systems from figures indicated.
- B. Adjust hydronic systems to plus or minus 10 percent of design conditions indicated.

3.4 ADJUSTING

- A. Recorded data shall represent actually measured, or observed condition.
- B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- C. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- D. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
- E. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Government Representative.
- F. Check and adjust systems approximately six months after final acceptance and submit report.

3.5 AIR SYSTEM PROCEDURE

- A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities.
- C. Measure air quantities at air inlets and outlets.

- D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
- F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.
- G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.

3.6 WATER SYSTEM PROCEDURE

- A. Adjust water systems to provide required or design quantities.
- B. Use calibrated fittings and pressure gages to determine flow rates for system balance. Where flow-metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.
- C. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.
- D. Effect system balance with automatic control valves fully open to heat transfer elements.
- E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.

END OF SECTION

PART 1 GENERAL**1.1 SUMMARY**

- A. This section applies to conduit, conduit fittings, conduit bodies, hangers, supports, and clamps required for a complete electrical raceway between boxes and devices as indicated on the drawings and specified herein.

1.2 CODES AND STANDARDS

- A. National Fire Protection Association (NFPA) Standard:
 - 1. 70-98 National Electrical Code (NEC).
- B. Underwriters Laboratories, Inc. (UL) Standards:
 - 1. 1-00 Flexible Metal Conduit.
 - 2. 6-00 Rigid Metal Conduit-Steel.
 - 3. 360-96 Liquid-Tight Flexible Steel Conduit.
 - 4. 514B-97 Fittings for Cable and Conduit.
 - 5. 797-00 Electrical Metallic Tubing.

PART 2 PRODUCTS**2.1 MATERIALS**

- A. Rigid metal conduit: UL 6.
- B. Fittings for rigid metal conduit: UL 514B.
- C. Clamps, straps, and hangers: Malleable iron or steel, zinc or cadmium plated.
- D. Flexible metal conduit: UL 1.
- E. Fittings for flexible metal conduit: UL 514B.
- F. Conduit bodies: Aluminum with cover and gasket.
- G. Sealing compound: Silicone-based flexible sealant.
- H. Liquid-tight flexible metal conduit: UL 360.
- I. Electrical metallic tubing (EMT): UL 797.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install exposed conduit parallel or perpendicular to walls, structural members, or intersections of vertical planes or ceilings.
- B. Install rigid conduit in accordance with the requirements of Article 346 of the NEC.
- C. Provide rigid conduit bushings in accordance with Article 346-8 of the NEC.
- D. Make rigid conduit bend radii in accordance with Table 346-10 of the NEC.
- E. Support rigid conduit with pipe straps, hangers, or clamps at intervals not exceeding those specified in Articles 346-2 and 348-12 of the NEC.
- F. Use stuff boxes and cork fittings to prevent entrance of water and debris during construction prior to completion of conduit installations.
- G. Provide gaskets for condulets and use compatible sealing compound with the conductor insulation to prevent water entry.
- H. Make conduit electrically and mechanically continuous in accordance with Articles 300-10 and 300-12 and ground it in accordance with Article 300-9 of the NEC.
- I. Install flexible metal conduit in accordance with Article 350 of the NEC. In wet locations, install liquid-tight flexible conduit in accordance with Article 351 of the NEC. Use a short section of liquid-tight flexible conduit at lighting connections and components subject to vibration or periodic removal for maintenance.
- J. Do not weld support conduit brackets or other items to pressure piping of ducting, or structural members except as indicated or by specific approval of the Government representative.
- K. Cut conduit square using saw or pipecutter; debur cut ends.
- L. Install EMT in accordance with the requirements of Article 348 of the NEC.
- M. Provide EMT conduit couplings and connectors in accordance with Article 348-8 of the NEC.
- N. Support EMT conduit with pipe straps, hangers, or clamps at intervals not exceeding those specified in Article 348-12 of the NEC.

END OF SECTION

SECTION 16120
WIRES AND CABLES

PART 1 GENERAL**1.1 SUMMARY**

- A. This section applies to 600-volt wire and cable as indicated on the drawings and specified herein.

1.2 CODES AND STANDARDS

- A. American Society for Testing and Materials (ASTM) Standard:
 - 1. B8-99 Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
- B. National Fire Protection Association (NFPA) Standard:
 - 1. 70-98 National Electrical Code (NEC).
- C. Underwriters Laboratories, Inc. (UL) Standard:
 - 1. 1581-00 Electrical Wires, Cables, and Flexible Cords.

1.3 SUBMITTALS

- A. Product data: Manufacturers' information and verification that materials meet the specification outlined in paragraph 2.1.

PART 2 PRODUCTS**2.1 MATERIALS**

- A. Wires meeting UL 1581 and ASTM B8: Minimum working voltage of 600 volts conforming to UL 1581 unless otherwise shown; copper conductor material; UL Type THW or XHHW insulation for wires American Wire Gage (AWG) No. 8 and larger; UL Type THW, THWN, or THHN insulation for wires AWG No. 10 or smaller.
- B. EIA RS-485 TP line cable - Tray cable 600V 90°C standard (7x26) AWG No. 18, shielded pair Beldon 1120A or equal.

PART 3 EXECUTION**3.1 INSTALLATION**

- A. Install wires and cables in raceways. Complete raceway installation prior to pulling or installing wires and cables.

- B. Make wires and cables mechanically and electrically continuous between outlets and devices in accordance with Article 300-13 of the NEC.
- C. Protect wires and cables from physical damage to the conductor, insulation, and jacket during insertion into raceways. Pulling lubricants, if used, shall not cause deterioration of the insulation and jackets of the wires and cables.
- D. Fill raceway in accordance with Article 348-6 of the NEC.
- E. Support wires and cables in vertical raceways in accordance with Article 300-19 of the NEC.
- F. Group wires and cables in raceways as shown on the drawings.
- G. Prior to making final connections, test all wires and cables rated at 600 V or less, in the presence of the Government representative, as follows:
 - 1. Test each conductor for continuity from end to end using an ohmmeter, low voltage telephone, buzzer, low voltage lamp, or other testing device designed to measure amperage, voltage, and resistance.
 - 2. Test each conductor for insulation resistance to ground and to each other conductor in the same cable or raceway using a megohm tester (megger) and applying a DC voltage of at least 80 percent of the conductor insulation voltage rating. Insulation resistance shall exceed 500 megohms.
 - 3. Do not energize any conductor prior to completing the required tests and receiving concurrence from the Government representative.

END OF SECTION

SECTION 16124
WIRE CONNECTIONS AND DEVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Proper connections and terminations as indicated on the drawings and specified herein.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Wire nuts shall be a flame-retardant thermoplastic shell with a double thick protective end cap and an expanding wire spacing on the inside and contoured wings on the outside.
- B. Electrical tape shall be 7-mils vinyl plastic insulation, corrosion-resistant, black, and 3/4-inch width.
- C. Conductive anti-seize compound shall be a homogenized blend of colloidal copper and rust and corrosion inhibitor that flows easily into the threads.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Joints between conductors No. 14AWG through No. 8AWG at fixtures, devices, and junction points shall be made with insulated spring type wire nuts of the wing-nut design.
- B. Conductive anti-seize compound shall be used on all fuse ferrules and blades, switch wiping contacts, ground connections, and all copper to copper lugs and connections.

END OF SECTION

PART 1 GENERAL**1.1 SUMMARY**

- A. This section applies to device, pull, and junction boxes as indicated on the drawings and specified herein.

1.2 CODES AND STANDARDS

- A. National Fire Protection Association (NFPA) Standard:
 - 1. 70-98 National Electrical Code (NEC).
- B. Underwriters Laboratories, Inc. (UL) Standards:
 - 1. 50-99 Enclosures for Electrical Equipment.
 - 2. 514A-98 Metallic Outlet Boxes.
 - 3. 514B-98 Fittings for Cable and Conduit Fourth Edition.

1.3 SUBMITTALS

- A. Manufacturer's descriptive literature (catalog cuts) of electrical boxes proposed for incorporation into the work.

PART 2 PRODUCTS**2.1 MATERIAL**

- A. Device boxes: UL 514A and NEC Article 370.
- B. Junction boxes: UL 50.
- C. Fittings: UL 514B and NEC Article 370.

PART 3 EXECUTION**3.1 INSTALLATION**

- A. Provide a box or fitting for each wiring device and fixture as required in accordance with Article 300 of the NEC.
- B. Provide a pull box every 100 feet of conduit run or when the number of bends requires a box for ease of wire installation. Do not allow cumulative bends between pull boxes or device outlet boxes to exceed 360 degrees.

- C. Securely anchor outlet boxes and set them level and plumb in accordance with Article 370 of the NEC.
- D. Number of conductors in boxes shall not exceed the maximum permitted by Tables 370-6(a) and 370-6(b) of the NEC.

END OF SECTION

SECTION 16190
SUPPORTING DEVICES

PART 1 GENERAL**1.1 SECTION INCLUDES**

- A. All supporting members, devices, hangers, clips, and fasteners required to properly support and fasten all electrical equipment, as indicated on the drawings and as specified herein.

1.2 CODES AND STANDARDS

- A. National Fire Protection Association (NFPA) Standard:
 - 1. 70-98 National Electrical Code (NEC).

PART 2 PRODUCTS**2.1 MATERIALS**

- A. Support channel shall be 1-5/8 by 1-5/8 inches by No. 13 gauge with all matching accessories and fittings.
- B. Support angles, unless specifically noted otherwise on drawings, shall be 3-1/8 by 1-5/8 inches by No. 12 gauge slotted angle.
- C. Threaded rod shall be 3/8-inch diameter minimum.
- D. Toggle bolts shall be 3/16-inch diameter minimum.
- E. Self-drilling anchors shall be 3/8-inch minimum.
- F. Screws shall be self-tapping pan head type or machine screws.
- G. Jack chain shall be No. 9 minimum.
- H. Support wire shall be No. 9 gauge steel.
- I. Fasteners shall be used to support conduit, outlet boxes and lighting fixtures to structural members. Fasteners shall be of a type designed and intended for use in the base material to which the material or support is to be attached.
- J. All equipment shall be either hot dip galvanized or cadmium plated. Paint all field cut ends of supporting equipment with galvanizing paint to prevent rusting.

2.2 METHOD ANCHORING

- A. Solid masonry and concrete.
 - 1. Steel expansion anchors not less than 1/4-inch bolt size embedded not less than 1-1/8 inches into structure.
 - 2. Power set fasteners not less than 1/4-inch diameter with depth of penetration not less than 3 inches.
 - 3. Anchors of fasteners attached to concrete ceilings shall be vibration resistant.
- B. Hollow masonry.
 - 1. Toggle bolts: Toggle bolts supported only by plaster are not acceptable.
- C. Metal structures.
 - 1. Machine screws.
- D. Metal studs.
 - 1. Sheet metal screws and extension bars or fasteners.
- E. Unacceptable anchors.
 - 1. Attachment by wood plugs, rawl plug, plastic, lead or soft metal anchors, or wood blocking is not acceptable. Chain, wire, or perforated strap shall not be used to support or fasten conduit.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Support raceway and conduit at intervals not exceeding those specified in articles 366-2 and 388-12 of the NEC.
- B. Support boxes independently from the conduit. Use structural members where possible and fasten boxes as specified in paragraph 2.2. In metal stud partitions fasten boxes to stud box or extension bar hangers. Fasten hangers between two studs.
- C. Provide all fixture supports in accordance with the NEC.

END OF SECTION

SECTION 16195
ELECTRICAL IDENTIFICATION

PART 1 GENERAL**1.1 SECTION INCLUDES**

- A. Nameplates and labels.
- B. Conduit markers.

1.2 CODES AND STANDARDS

- A. National Fire Protection Association (NFPA) Standard:
 - 1. 70-98 National Electrical Code (NEC).

1.3 SUBMITTALS

- A. Product data: Furnish catalog data for nameplates and labels.

1.4 REGULATORY REQUIREMENTS

- A. Conform to requirements of the NEC.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc.

PART 2 PRODUCTS**2.1 NAMEPLATES AND LABELS**

- A. Nameplates: Engraved three-layer, laminated plastic, white letters on black background.
- B. Locations: Each electrical distribution and control equipment enclosure.
- C. Letter size:
 - 1. Use 1/8-inch letters for identifying individual equipment and loads.
 - 2. Use 1/4-inch letters for identifying grouped equipment and loads.

2.2 CONDUIT MARKERS

- A. Description: Black letters on orange background with the word "ELECTRIC" on marker.
- B. All exposed surface-mounted conduit.

- C. Spacing: Within 20 feet of electrical enclosures and at 60-foot intervals in long runs of conduit. Install markers in conspicuous places near entrances or exits.
- D. System: 120/208 volt as indicated on drawings.
- E. Letter size:
 - 1. Use 1/2-inch letters for conduit size 1 1/4-inch or less.
 - 2. Use 3/4-inch letters for conduit size 1 1/2 through 2 inches.
 - 3. Use 1 1/4-inch letters for conduit size 2 1/2 through 6 inches.

PART 3 EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive nameplates or markers.

3.2 APPLICATION

- A. Install nameplate parallel to equipment lines.
- B. Secure nameplate to equipment front with screws.
- C. Secure nameplate to outside surface of door on panelboard.

END OF SECTION

SECTION 16440
DISCONNECT SWITCHES

PART 1 GENERAL**1.1 SUMMARY**

- A. This section applies to safety switches as indicated on the drawings and specified herein.

1.2 CODES AND STANDARDS

- A. National Electrical Manufacturer's Association (NEMA) Standards:
 - 1. 250-97 Enclosures for Electrical Equipment (1000 Volt Maximum).
 - 2. ICS 6-93 Industrial Control and Systems Enclosures.
- B. National Fire Protection Association (NFPA) Standard:
 - 1. 70-98 National Electrical Code (NEC).
- C. Underwriters Laboratories (UL) Standard:
 - 1. 98-98 Enclosed and Dead-Front Switches.

1.3 SUBMITTALS

- A. A complete itemized listing of equipment and materials proposed for incorporation into the work that includes an item number, the quantity of items proposed and the name of the manufacturer of each item.
- B. Manufacturer's descriptive literature (catalog cuts) of each item proposed for incorporation into the work.

PART 2 PRODUCTS**2.1 MATERIALS**

- A. Safety switches: Class 1 in accordance with NEMA ICS 6 and 250, and UL 98.

PART 3 EXECUTION**3.1 INSTALLATION**

- A. Install disconnecting devices as shown on the drawings, and identify in accordance with Article 110-22 of NEC.

- B. Locate each disconnecting device so that it is readily accessible to the equipment serviced, and in accordance with Article 430 and other related Articles of the NEC.
- C. Mount disconnects in accordance with Articles 110-13(a) and 300-11 of the NEC.
- D. Ground disconnects in accordance with Article 250 of the NEC.
- E. Identify disconnect with an engraved laminated plastic nameplate (3/4-inch white letters on a black background) permanently attached to the front cover with a legend describing the equipment served and fuse size (when applicable).

END OF SECTION

**SECTION 16450
GROUNDING****PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Grounding of metallic conduits, raceways, supports, motors, controls, cabinets, and equipment, as indicated on the drawings and specified herein.

1.2 CODES AND STANDARDS

- A. National Fire Protection Association (NFPA) Standard:
 - 1. 70-98 National Electrical Code (NEC).

PART 2 PRODUCTS**2.1 MATERIALS**

- A. Connections at ground bus in panel boards shall be made with UL approved lugs.
- B. Grounding conductor shall be copper and sized in accordance with NEC 250-95 and colored in accordance with NEC 210-5.

PART 3 EXECUTION**3.1 INSTALLATION**

- A. Grounding system shall be installed in accordance with Article 250 of the NEC.
- B. Provide separate grounding conductor in each and every conduit and branch circuit wiring.
- C. Ground all exposed non-current-carrying metallic parts of electrical equipment, conduit systems, junction boxes, and neutral conductors to the ground grid.

END OF SECTION

SECTION 16475
OVERCURRENT PROTECTIVE DEVICES

PART 1 GENERAL**1.1 SUMMARY**

- A. This section applies to molded-case circuit breakers and fuses as indicated on the drawings and specified herein.

1.2 CODES AND STANDARDS

- A. National Fire Protection Association (NFPA) Standard:
 - 1. 70-98 National Electrical Code (NEC).
- B. Underwriters Laboratories, Inc. (UL) Standard:
 - 1. 198E-88 Class R Fuses.
 - 2. 489-00 Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.

1.3 SUBMITTALS

- A. A complete itemized listing of equipment and materials proposed for incorporation into the work that includes an item number, the quantity of items proposed, and the name of the manufacturer of each item.
- B. Manufacturers' descriptive literature (catalog cuts) of each item proposed for incorporation into the work.

PART 2 PRODUCTS**2.1 MATERIALS**

- A. Molded case circuit breakers: UL 489.
- B. Fuses: Class R, UL 198E.

PART 3 EXECUTION**3.1 INSTALLATION**

- A. Provide circuit breakers in panelboards as indicated on the contract drawings, and with a minimum interrupting rating of 22,000 rms amperes symmetrical.
- B. Connect branch circuit conductors as indicated on the contract drawings.

- C. Provide a typed directory of circuits as indicated on the contract drawings.
- D. Install fuses in fused safety switches with a minimum interrupting rating of 100,000 rms amperes symmetrical.
- E. Install circuit breakers and fuses in accordance with Article 240 of NFPA 70.
- F. Provide adhesive label on inside door of each switch indicating UL fuse class and size for replacement

END OF SECTION

PART 1 GENERAL**1.1 SUMMARY**

- A. This section applies to motor starters as indicated on the drawings and specified herein.

1.2 CODES AND STANDARDS

- A. National Electrical Manufacturer's Association (NEMA) Standard:
 - 1. 250-97 Enclosures for Electrical Equipment (1000-Volts Maximum).
- B. National Fire Protection Association (NFPA) Standard:
 - 1. 70-98 National Electrical Code (NEC).

1.3 SUBMITTALS

- A. A complete itemized listing of equipment and materials proposed for incorporation into the work that includes an item number, the quantity of items proposed, and the name of the manufacturer of each item.
- B. Manufacturers' descriptive literature (catalog cuts) of each item proposed for incorporation into the work.

PART 2 PRODUCTS**2.1 MATERIALS**

- A. Motor starters: Rated in accordance with Article 440-41 of the NEC for hermetic motors and in accordance with Article 430-83 of the NEC for non-hermetic motors; UL-listed line voltage magnetic type with thermal overload and low voltage protection, auxiliary interlocks, NEMA 1 general purpose enclosures conforming to NEMA 250. Combination starters of the fusible disconnect type may be used.
- B. Manual motor starters: Manually-operated toggle switch equipped with one thermal overload relay mounted in NEMA 1 enclosure.
- C. Combination starter: Single speed, non-reversing, 3-pole, 60 Hertz, 600 VAC maximum, 7-1/2 hp, NEMA Size 1, 50 amp, 240 volt rated for Class I, Division II hazardous locations.

- D. Manual starter: 240 volt maximum, 2 hp maximum, single phase, NEMA Size M-O rated for Class I, Division II hazardous locations.
- E. Integral horsepower manual motor starters: Manually-operated push button equipped with thermal overload protection in a NEMA 12 enclosure, 2-pole, 3 hp maximum, 115 volts, single phase.
- F. Combination starter: Fusible disconnect switch type, 600 volts maximum, 3-phase, non-reversing magnetic type with three thermal overload relays, NEMA size 0, NEMA Type 12 enclosure; 30 amp fuse clip size, 240 volt motor starter voltage, fuse as shown on the drawings, 2 hp maximum.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Provide each motor with an individual motor starter unless the application is specifically excepted by Article 430 and 440 of the NEC.
- B. Install motor starters in accordance with the manufacturer's recommendations.
- C. Install suitably sized thermal units in all motor starters. Do not jump or bypass thermal overloads.
- D. Identify each motor starter with an engraved laminated plastic nameplate (1/4-inch white letters on black background) permanently attached to the front of the cover with a legend describing the equipment served (Example: Air Handling Unit No. 1 Motor).
- E. Mount motor starters in accordance with Articles 110-13(a) and 300-11 of the NEC.
- F. Ground motor starters in accordance with Article 250 of the NEC.

END OF SECTION